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March 31, 1980

Energy Research Abstracts

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UNITED STATES DEPARTMENT OF ENERGY

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ENERGY RESEARCH ABSTRACTS

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Ruth M. Davis
Assistant Secretary
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Joseph G. Coyne
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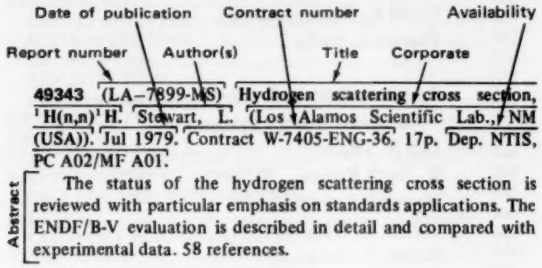
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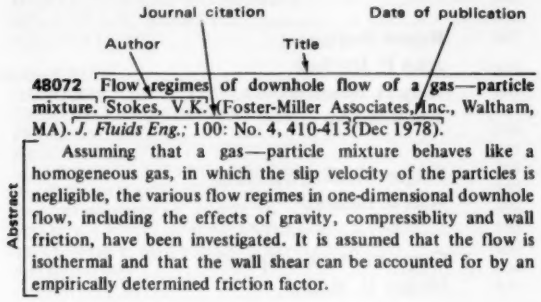
49343 (LA–7899-MS) Hydrogen scattering cross section, $^1H(n,n)^1H$. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
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48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

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is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, $^1H(n,n)^1H$, 4:49343 (LA–7899-MS)
Low temperature physics and engineering. Quarterly progress report, January 1–March 31, 1979, 4:48988 (LA–7848-PR)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, $^1H(n,n)^1H$, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

HYDROGEN 1 TARGET/NEUTRON REACTIONS
Hydrogen scattering cross section, $^1H(n,n)^1H$ (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	**California Univ., Livermore (USA). Lawrence Livermore Lab.**	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	4:49343	Dep. NTIS, PC A02/MF A01
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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 8663, 8700

8000 (NP—24112) **Illinois energy production: 1960-1977.** Biermann, W.W.; Hill, L. (Illinois Dept. of Business and Economic Development, Springfield (USA). Office of Research). Apr 1979. 36p. NTIS.

This report contains historical Illinois energy production data by fuel type, i.e., coal, petroleum, petroleum refining, and natural gas. Data on electricity generation are included, broken down by fuel used in the generation. These data have been assembled to serve as a base for energy policy analysis.

8001 (ORNL/TM—7031) **Fossil Energy Program. Progress report for July 1979.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 72p. Dep. NTIS, PC A04/MF A01.

This report - the sixtieth of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion development, materials engineering, a coal equipment test program, an atmospheric fluid bed combustor for cogeneration, engineering studies and technical support, process and progam analysis, environmental assessment studies, magnetic beneficiation of dry pulverized coal, technical support to the TVA fluid bed combustion program, coal cogeneration/district heating plant assessment, chemical research and development, and technical support to major liquefaction projects.

8002 (ORNL/TM—7057) **Fossil Energy Program. Progress report for August 1979.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 98p. Dep. NTIS, PC A05/MF A01.

This report - the sixty-first of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion development, materials engineering, a coal equipment test program, an atmospheric fluid bed combustor for cogeneration, engineering studies and technical support, process and program analysis, environmental assessment studies, magnetic beneficiation of dry pulverized coal, technical support to the TVA fluid bed combustion program, coal cogeneration/district heating plant assessment, chemical research and development, and technical support to major liquefaction projects.

8003 (ORNL/TM—7095) **Fossil Energy Program. Progress report for September 1979.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 86p. Dep. NTIS, PC A05/MF A01.

This report - the sixty-second of a scries - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion development, materials engineering, a coal equipment test program, an atmospheric fluidized bed combustor for cogeneration, engineering studies and technical support, process and program analysis, environmental assessment studies, magnetic beneficiation of dry pulverized coal, technical support to the TVA fluidized bed combustion program, coal cogeneration/district heating plant assessment, chemical research and development, and technical support to major liquefaction projects.

8004 (ORNL/TM—7144) **Fossil Energy Program. Progress report for October 1979.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 79p. Dep. NTIS, PC A05/MF A01.

This report, the sixty-third of a series, is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion development, materials engineering, a coal equipment test program, an atmospheric fluid bed combustor for cogeneration, engineering studies and technical support, process and program analysis, environmental assessment studies, magnetic beneficiation of dry pulverized coal, technical support to the TVA fluid bed combustion program, coal cogeneration/district heating plant assessment, chemical research and development, and technical support to major liquefaction projects.

PROCESSING

REFER ALSO TO CITATION(S) 8634

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 8033, 8038, 8041, 8055

8005 (COO—0059-T1) **Pre-methanation purification study: removal of low concentration gaseous sulfur compounds (catalyst poisons).** Iaccarino, E.P.; Lieberman, M.; Taylor, W.F. (Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Lab.). Feb 1978. Contract EY-76-C-02-0059. 144p. Dep. NTIS, PC A07/MF A01.

Before catalytic methanation can be used for the commercial production of synthetic natural gas from synthesis gas, the problem of methanation catalyst deactivation must be solved. The nickel catalyst used is easily poisoned by sulfur compounds. It was the purpose of this program to identify and develop a viable and effective pre-methanation purification system to protect the methanation catalyst and therby promote viable coal gasification by the SYNTHANE process. A review and analysis was made of state of the art gaseous sulfur compound removal processes. On the basis of this extensive review, a system was selected for a detailed laboratory evaluation to obtain needed design data. A copper-chromium oxide impregnated activated carbon was selected as the test sorbent and evaluated for its ability to remove specified levels of H_2S, COS, CS_2 mercaptans and thiophenes. The levels used of these respective sulfur compounds was dictated by the anticipated performance of the Benfield Hot Potassium Carbonate Process selected for bulk removal of acid gases in the Synthane Process. Experimental runs were made using single component and multicomponent sulfur compound gaseous mixtures in a simulated synthesis gas. Adsorption breakthrough curves were evaluated and estimates were made of the time for breakthrough to occur, and the approximate maximum values of volume of gas that could be processed/volume of carbon used. Using this data, estimates of sorbent requirements, costs, and environmental handling constraints were made for a system to be used in the 72 TPD SYNTHANE pilot plant.

8006 (EPA/600/9—78-022, pp 221-251) **Interagency coal cleaning technology developments.** Kilgore, J.D. (Environmental Protection Agency, Research Triangle Park, NC); Hucko, R.E. Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

EPA's interagency energy/environmental program is subdivided into three basic elements. The principal objectives of activities under these subprograms are to assess and develop coal cleaning technology for removing pollutant-forming contaminants from coal, to evaluate the environmental impacts of coal cleaning processes, and to develop improved methods of controlling pollution from coal preparation. An overview of regulatory activities related to coal cleaning is presented, along with an analysis of future coal-cleaning R and D priorities, and a summary of progress on the interagency coal cleaning R and D program. Research and development activities under the interagency coal cleaning program are responsive to changing regulatory requirements and energy goals. A review of the technical status of coal cleaning and associated regulatory activities provides the context for the discussion of progress on recent coal cleaning R and D. The past year has been one of transition. Potential applications of coal cleaning, and hence R and D goals, have been greatly affected by new environmental legislation and impending energy legislation. Studies are now in progress to identify the technical capability and costs of various coal cleaning technologies for removing sulfur and other contaminants from coal. Progress has been made in the development of physical cleaning techniques for improved pyrite removal and coal energy recovery. Progress continues in the development of chemical coal cleaning processes, but impending environmental standards result in uncertainties concerning future market applications. Methodologies have been developed for the environmental assessment of coal preparation processes, and tests are scheduled to begin shortly. The conditions under which trace elements are leached from coal preparation wastes have been identified, and preliminary studies have identified the effectiveness of several pollution control techniques. (JGB)

HYDROGENATION

8007 Coal conversion by flash hydropyrolysis and hydrogasification. Oberg, C.L.; Combs, L.P.; Silverman, J. (Rockwell Int, Canoga Park, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 402-408(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Results are described from two programs directed toward development of high-mass-flux, short-residence-time reactors for conversion of coal into high-value gases and liquids. For either liquefaction or gasification, pulverized coal is rapidly and thoroughly mixed with preheated hydrogen and allowed to react for periods ranging from a few milliseconds to a few seconds. In the liquefaction case, the reaction is subsequently quenched rapidly. Successful reactor tests have been carried out at nominal coal flowrates of one-quarter-and 1-ton/hour with caking bituminous coals. Up to 1500 pounds of coal has been processed in single test with test durations up to 1 hour. Favorable quality liquids and gases have been produced with overall conversions consistent with the requirements of a commercial plant. Results from liquefacton tests with western Kentucky bituminous coals and gasification tests with bituminous and sub-bituminous coals are described.

GASIFICATION

REFER ALSO TO CITATION(S) 8005, 8041, 8209, 8852, 9393

8008 (ANL—79-56) Materials technology for coal-conversion processes. Seventeenth quarterly report, January-March 1979. Ellingson, W.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 111p. Dep. NTIS, PC A06/MF A01.

Studies of slag attack on refractories were continued, utilizing conditions relevant to MHD applications. Addition of 10 wt % K_2O seed to the slag did not increase its corrosive effect on the refractories tested. A hot gas-stream cleanup erosion-monitoring system using an ANL-developed nondestructive ultrasonic system was installed at the Morgantown Energy Technology Center (METC) during this period and was 75% completed. Characteristic-slope values obtained from broadband and resonant-band acoustic-emission transducers during rapid heating of a 95% Al_2O_3 refractory panel are consistent with theory. Corrosion information on type and thickness of corrosion-product layers was obtained on Incoloy 800, 310 stainless steel, Inconel 671 and 871 and 982°C. Fluid-bed corrosion studies involving sulfation accelerators have shown that addition of 0.3 mol % $CaCl_2$ has no significant effect on corrosion behavior of the alloys studied. However, 0.5 mol % NaCl or 1.9 mol % Na_2CO_3 increases the corrosion rates of most materials. Failure analyses were performed on components from the slagging gasifier and liquefaction unit at the Grand Forks Energy Technology Center, and a ball valve from the METC Valve Dynamic Test Unit.

8009 (COO—2904-12) Chemical and physical stability of refractories for use in coal gasification. Third annual progress report, May 1, 1978-April 30, 1979. Rahman, S.F.; Day, D.E. (Missouri Univ., Rolla (USA)). 22 May 1979. Contract EY-76-S-02-2904. 45p. Dep. NTIS, PC A03/MF A01.

Of all the refractories examined, the cement-bonded castables showed the most chemical reaction with the test atmospheres. In most cases, the reactions consisted of the formation of boehmite ($Al_2O_3.H_2O$) and $CaCO_3$ in saturated atmospheres (below 500°F) while only $CaCO_3$ formed in unsaturated atmospheres (1000°F). The formation of boehmite, especially in the dense alumina castables, resulted in large increases (doubling or tripling) of the flexural strength. No significant differences in chemical reactivity was noted between the three commercial calcium aluminate cements examined nor between different commercial or laboratory-prepared castables. Any differences between different manufacturers of the same type of refractory is at best a second order factor affecting their performance for the conditions investigated. Other property changes, such as weight, dimension, density, and porosity, especially those of intermediate alumina and insulating castables, were small. The physical/mechanical properties of phosphate-bonded refractories showed relatively little change except for specimens exposed to saturated atmospheres where a large reduction in flexural strength occurred. This reduction in strength is attributed to chemical attack of phosphate bond phases by high pressure, saturated steam. Steam and CO/CO_2 were the only gases found to react significantly with the refractories.

8010 (DOE/TID/6646—1) Assessment of the labor impacts of the commercialization of coal gasification systems. Lamson, J.E.; Donakowski, T.D. (Institute of Gas Technology, Chicago, IL (USA)). Oct 1979. Contract EU-78-C-01-6646. 82p. Dep. NTIS, PC A05/MF A01.

This report is divided into two parts, which are indexed separately: (1) forecast of rate of commercialization of coal gasification and (2) labor requirements for construction and operation of coal gasification plants. (LTN)

8011 (DOE/TID/6646—1, pp 1-29) Forecast of the possible high and low rates of the commercialization of high-Btu coal gasification. Lamson, J.E. Oct 1979.

In Assessment of the labor impacts of the commercialization of coal gasification systems.

There is a high probability that, unless development of a coal gasification industry is declared to be in the National interest and the declaration is followed by appropriate and responsible legislative and regulatory action, there will be few as 6 commercial-scale plants onstream by the year 2000; the problem, of course, with coal gasification is that it is a very expensive energy option. This has, so far, been an insurmountable barrier to its further development and is one that with inflation is getting larger. It is also a barrier that points out the inconsistencies of current energy strategies and their implementation. A conclusion from this analysis is one that can be derived from the substantial difference between our high and low estimate of the probable commercialization rate of coal gasification. Given the current economic situation that has been brought about by high fuel prices and the bleak picture we have of the long-term availability of oil and gas supplies, one must conclude that energy planning in the United States is in total disarray. After all, 20 years is not that far off given the lead times required to plan and construct these plants and yet we cannot accurately say within 38 plants (low value, 6; high value, 44) how many are likely to come onstream. One cause of this problem, uncovered in the course of this analysis, is that accepted forecasts of coal gasification commercialization stated how many plants could be built. We point out that both the low and high values are boundaries. In the case of the high value, there is a low probability it will develop due to the current inability to realize the DOE's commercialization strategies or to make the necessary pricing and regulatory changes required for commercialization. The low value boundary is also a low probability figure because energy shortages and the high cost of imported fuels will eventually force some active Government support.

8012 (DOE/TID/6646—1, pp 31-72) Labor requirements of commercial-scale low-, medium-, and high-Btu coal gasification systems. Donakowski, T.D. Oct 1979.

In Assessment of the labor impacts of the commercialization of coal gasification systems.

This report presents estimates of the timing, skills, and number of people required to construct low-, medium-, and high-Btu coal gasification systems. The methodologies used include relevance analysis, to characterize the systems, and factored estimating, to determine the construction labor requirements. These estimates are to be used to define and evaluate impacts of the labor requirements of coal gasification.

8013 (EGG—1183-2376) Spectral characterization of selected coal processing by-products. Franks, L.A.; Capelle, G.A. (EG and G, Inc., Goleta, CA (USA)). May 1978. Contract EY-76-C-08-1183. 24p. Dep. NTIS, PC A02/MF A01.

The results of a spectral characterization of extracts from treatment processes are reported. Corrected emission spectra were obtained in the region 260-600 nm using spectrally narrow 250-nm

and 337-nm exciting light. The fluorescence decay time and the fluorescence quantum efficiency were also measured. Decay times were in the 6 to 11.5 nsec range and showed no evidence of concentration quenching over the range of concentrations studied. Quantum efficiencies were measured relative to the standard quinine bisulfate and range from 1.2×10^{-1} to 7.4×10^{-3} (photns emitted per photon absorbed).

8014 (EPRI-AF—1151) **Design of refractories for coal gasification and combustion systems. Final report.** Vojnovich, T.; Keairns, D.L.; Yang, W.C.; Vaux, W.G.; Weaver, E.P.; Stiles, D.P.; Derge, G. (Westinghouse Research and Development Center, Pittsburgh, PA (USA); Harbison-Walker Refractories, Pittsburgh, PA (USA); Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Jul 1979. 199p. Dep. NTIS, PC A09/MF A01.

For gasification and combustion systems of interest to utilities, the design of wear-resistant refractories and refractory linings for the erosion/corrosion and slagging conditions is important and necessary to minimize losses in system efficiencies, higher production costs, and excessive downtime associated with lining wear and failure. Under the sponsorship of the Electric Power Research Institute, the Westinghouse Electric Corporation conducted a program to design refractories for use under the high-temperature erosion/corrosion and slagging conditions found in coal gasification and combustion systems. The major tasks designed to meet this objective were: (1) determine the state-of-the art of refractories for gasification and combustion systems, (2) evaluate the behavior of refractories under erosion/corrosion and slagging conditions in laboratory and large-scale test facilities, (3) determine wear and failure mechanisms under these test conditions, and (4) establish design criteria for the refractories. For the erosion/corrosion conditions, evaluation of refractories in the small-scale direct impingement test facility at room temperature and in the large-scale pneumatic impingement test facility at room and high temperatures was very successful though further evaluation under more corrosive environments is needed to confirm the results obtained in the program. Evaluation of refractories in the large-scale fluidized-bed test facility was not as successful due to the low rates of wear observed and the difficulties encountered in specimen size, geometry, and placement in the test bed.

8015 (EPRI-AF—1179(Vol.1)) **Simulation of a Texaco gasifier. Volume 1. A steady-state model.** Lupa, A.J.; Kliesch, H.C. (Texaco, Inc., Houston, TX (USA)). Sep 1979. 65p. Dep. NTIS, PC A04/MF A01.

A steady-state model of a Texaco entrained coal-fired pilot plant gasifier has been developed. In this simple model, the gasifier is represented by a perfectly stirred tank reactor in combination with a plug flow reactor. The model includes both gas and solid phase reactions, interphase mass and energy transfer and wall heat loss. Coal particle size distributions may be used. The model was tested with actual pilot plant data on four different coals. Good agreement between predicted results and actual observations was obtained particularly in the model's ability to predict the effect of oxygen-carbon ratio, slurry concentration and oxidant concentration on gasifier performance. The simple model performs satisfactorily and will be extended to include the prediction of transient operation of an entrained pilot plant gasifier.

8016 (FE—2416-43(Vol.3)) **Conceptual design of a coal-to-methanol-to-gasoline commercial plant. Volume 3: environmental. Second interim final report, August 31, 1977-March 1, 1979.** (Badger Plants, Inc., Cambridge, MA (USA)). Mar 1979. Contract EX-76-C-01-2416. 216p. Dep. NTIS, PC A10/MF A01.

The coal conversion complex is designed for a feed rate of 63,000 tons per day of sized, washed coal. The basic process involves high temperature (2800°F to 3000°F), high pressure (500 psig) gasification of pulverized coal in an oxygen-blown gasifier to produce a syn-gas that must be cleaned, shifted to the proper hydrogen-carbon monoxide ratio, and converted to methanol by catalytic synthesis. The methanol thus produced is converted to gasoline and associated products by the Mobil Methanol-to-Gasoline process. Oxygen will be produced on the site at a rate of approximately 50,000 tons per day. The plant will produce 167,530 barrels per day of gasoline product, 14,690 barrels per day of isobutane and 9,140 barrels per day of C_3 LPG. The plant will occupy about 1500 acres. The complex is estimated to cost between $3.5 and $4.0 billion and will require an engineering and construction period of about eight years. Volume III of this conceptual design report is devoted entirely to environmental matters. It is our considered opinion that the control measures outlined will satisfy the Government authorities associated with the approval and authorization of a major coal conversion plant. To this end, this report has been prepared in sufficient detail to enable the Department of Energy to award the task of preparing an Environmental Impact Statement to a qualified organization after selection of the plant site.We estimate that clearance of the project through the approval procedure of the US Environmental Protection Agency will require a minimum of three years from the date of submission.

8017 (FE—2416-43(Vol.5)) **Conceptual design of a coal-to-methanol-to-gasoline commercial plant. Volume V. Alternate design studies. Second interim final report, August 31, 1977-March 1, 1979.** (Badger Plants, Inc., Cambridge, MA (USA)). Mar 1979. Contract EX-76-C-01-2416. 209p. Dep. NTIS, PC A10/MF A01.

Three design cases have been investigated for converting methanol to gasoline using the Mobil process. These are defined as Case A, which produces gasoline and byproduct LPG; Case B, which produces gasoline, high Btu gas, and byproduct LPG; and Case C which produces gasoline only. The LPG includes propane LPG and high purity isobutane. Base Case B is described in Volumes I and IV of this report. Alternate Cases A and C are described in part I of Volume V. Part II of this volume (V) contains additional process studies. Under Contract EX-76-C-01-2416 Modification No. A006, item (4) of the General Requirements requires economy of scale evaluations, and item (24) of the Scope of Work includes studies of Lurgi methanol synthesis recommendations, integration of Methanol-to-Gasoline facilities with a refinery, and recovery of aromatics from stabilized synthetic gasoline.

8018 (FE—2785-T2) **Design, engineering, and evaluation of refractory liner for slagging gasifier. First quarterly technical progress report.** Firestone, R.F.; Greaves, M.J.; Hales, C. (IIT Research Inst., Chicago, IL (USA)). Jan 1979. Contract ET-78-C-01-2785. 21p. Dep. NTIS, PC A02/MF A01.

The objectives of this 42 month program are: (a) To develop refractory lining systems which will provide minimum refractory wear with low total heat loss. (b) To determine the rate of wear of refractory systems under conditions simulating actual conditions in low and high Btu slagging gasifiers. (c) To develop design practices and specifications for refractory linings in large slagging gasifiers which can perform reliably for at least two years with only routine annual maintenance. The planned program is described.

8019 (FE—2798-62) **Test and evaluate the TRI-GAS low-Btu coal gasification process. Quarterly report, January-March 1979.** (Bituminous Coal Research, Inc., Monroeville, PA (USA)). May 1979. Contract ET-78-C-01-2798. 77p. Dep. NTIS, PC A05/MF A01.

Four tests were conducted in the PEDU. In each test, operation was attempted using all three stages of the system. These tests were conducted to observe the performance of the Stage 3 reactor. Although problems were encountered with frozen coal, equipment breakdowns, and insufficient nitrogen flow, the overall objective of the tests was accomplished. Operation of the individual reactors, however, showed that ash agglomerates were formed on the reactor walls rather than in the bed itself. Modifications were made in an attempt to eliminate the formation of the agglomerates. Laboratory tests continued to assess the ability of various theoretical models to predict char conversion in a fluid-bed reactor.

8020 (FE—2798-66) **Test and evaluate the TRI-GAS low-Btu coal gasification process. Quarterly report, April-June 1979.** (Bituminous Coal Research, Inc., Monroeville, PA (USA)). Jul 1979. Contract ET-78-C-01-2798. 38p. Dep. NTIS, PC A03/MF A01.

Three tests were conducted in the TRI-GAS PEDU. In the last two tests, the system was operated with the char and gas flows integrated in the process design mode. Smooth transfer of both char and gas between reactors was accomplished. Several minor equipment problems were encountered, but these will be alleviated through modifications. Work on the bench-scale equipment continued.

8021 (FE—3117-T2) **Fossil fuel processing technical/professional services. Technical progress report, September 1978-March 1979.** Pace, C.W. (UOP, Inc., Des Plaines, IL (USA); System Development Corp., McLean, VA (USA)). 1 Jul 1979. Contract ET-78-C-01-3117. 38p. Dep. NTIS, PC A03/MF A01.

This report covers the technical progress achieved during the initial six months of the UOP/SDC engineering and professional services contract with the Department of Energy's Division of Fossil Fuel Processing. Specific technical and management services have been provided in support of the Coal Conversion program. Seven tasks are underway in gasification programs and five in coal liquefaction programs. One study is underway by UOP/SDC's Advanced Research and Technology Group. In addition, systems engineering assistance has been provided DOE at the Pittsburgh Energy Technology Center. Significant delays have been encountered in implementing a number of the projects (mainly in the demonstration programs) because nondisclosure agreements between licensors to the industrial partners and UOP/SDC have not yet been completed.

8022 (FE—3240-T2) **Shift conversion and methanation in coal gasification: bench scale evaluation of a sulfur resistant catalyst. Quarterly progress report, January 1-March 31, 1979.** McCarty, J.G.; Meeker, D.; Wise, H. (SRI International, Menlo Park, CA (USA)). 18 Apr 1979. Contract ET-78-C-01-3240. 21p. Dep. NTIS, PC A02/MF A01.

The methanation (ME) kinetics of a commercial nickel catalyst and an iridium-promoted nickel catalyst were studied. The

methanation activities of each catalyst were evaluated in a gradientless Berty reactor with synthesis gas containing up to 25 vol % carbon monoxide at 523-556 K and a total pressure of one atmosphere. On a weight basis, the promoted catalyst exhibits twice the activity of the unpromoted commercial catalyst under these conditions. The observed reaction rate was limited by interparticle transport at high reaction rate and low CO concentration. The specific ME rates and their dependence on temperature and on CO concentration were evaluated for both catalysts.

8023 **Status of the HYGAS process development.** Bair, W.G.; Lau, F.S. Chicago, IL; Institute of Gas Technology (1979). 13p. (CONF-791108—10).

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

The purpose of this paper is to update the status of the developmental work performed by the Institute of Gas Technology on the conversion of coal to high-Btu, pipeline quality gas using the HYGAS Process. A pilot plant facility in Chicago, Illinois, has been devoted to these process development activities. Progress this year has included successful operations with Run-of-Mine (ROM) coal from the Illinois No. 6 seam, Peabody No. 10 Mine and the integration into the pilot plant of the new 400-ton coal/char storage system, which has successfully minimized gasifier upsets caused by upstream difficulties. The program is scheduled to continue operation with testing the gasification behavior of coals from Western Kentucky to further extend the HYGAS Process data base.

8024 (ORNL—5439) **Evaluation of an in situ coal gasification facility for producing M-gasoline via methanol.** Ulrich, W.C.; Edwards, M.S.; Salmon, R. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 250p. Dep. NTIS, PC A11/MF A01.

A conceptual process design and cost estimate is presented for a facility producing ~ 15,000 barrels of M-gasoline per day via methanol from synthesis gas generated by gasification of coal in situ. The design was based on experimental data and mathematical predictions from the Laramie Energy Technology Center on the linked vertical well in situ coal gasification process. In-place coal consumption is 20,000 tons/day, based on a subbituminous Wyoming coal. The capital investment was estimated to be $535 million in first-quarter 1978 dollars. M-gasoline product price was calculated as a function of the debt/equity ratio, annual earning rates on debt and equity, inplace coal cost, and plant factor (onstream efficiency). Using a debt/equity ratio of 70/30, an interest rate on debt of 9%, an after-tax earning rate on equity of 15%, an in-place coal cost of $5/ton, an LPG (propane) by-product credit of $4/$10^6$ Btu, and a plant factor of 90%, the product price of M-gasoline (including mixed-butane LPG) is ~ $0.90/gal at the plant gate. Calculated overall efficiency for the facility was 22%, based on in-place coal.

8025 (ORNL/TM—6585) **Survey of industrial coal conversion equipment capabilities: letdown valves.** Hatcher, D.W.; Andress, T.M.; Bush, W.A. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 117p. Dep. NTIS, PC A06/MF A01.

An investigation of the capability of manufacturers to supply letdown valves for the future coal conversion industry is presented in this report. Also discussed are valve trim and trim materials, the capability of manufacturers to supply them, economic considerations, and current technology of let-down valves and valve trims for severe-service applications. Results indicate that industry does not make, as a standard production item, any valve suitable for coal conversion let-down service. Modified oil-field choke valves and angle valves are the valves now most successfully used in pilot plants. Special valve trims and valve modifications have extended valve life, but not to the extent that will be required in the future coal conversion industry.

8026 (ORNL/TM—7090) **Nondestructive inspection of plasma-sprayed metallic coatings for coal conversion equipment.** Scott, G.W.; Snyder, S.D.; Simpson, W.A. Jr. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 70p. Dep. NTIS, PC A04/MF A01.

This report describes the results of a project to develop nondestructive inspection techniques for metallic wear- and process-resistant coatings used in coal system components. Physical properties, especially porosity, and the nominal 0.25 mm (0.010 in.) thickness complicate the inspection of these coatings. The class of coatings selected for laboratory evaluation were CoCrAlY (cobalt-chromium-aluminum-yttrium) types; the specific material used was a Union Carbide spray powder, UCAR LCO-7, which is Co-22.8% Cr-12.9% Al-0.6% Y, sprayed onto alloy 800 substrates. The desired inspection techniques were to: (1) detect cracks or holes in the coating; (2) measure the coating thickness from the coated side; and (3) detect lamellar flaws or separations within the coating layer or between the coating and the substrate. Surface methods (such as liquid penetrant), eddy currents, and radiography were investigated for crack and hole detection; eddy currents, x-ray fluorescence, and ultrasonics were investigated for thickness measurement; and ultrasonics and infrared thermography were investigated for lamellar flaw detection. In general, we determined that significant development effort was required to adapt even the more common and highly developed techniques to the coating inspection problems. Significant progress was made in a number of the investigations undertaken, but financial restraints prevented completion of the planned work.

8027 (PETC—0212-T1) **Gasification tests of bituminous coal chars. Project 61023 Final report, August 1-December 31, 1978.** Nandi, S.P.; Babu, S.P. (Institute of Gas Technology, Chicago, IL (USA)). May 1979. Contract EW-78-C-22-0212. 20p. Dep. NTIS, PC A02/MF A01.

Gasification tests of chars from two samples of bituminous coals (Samples A and B), received from the Pittsburgh Energy Technology Center, were conducted in steam, hydrogen, and a steam/hydrogen mixture (molar ratio of $H_2O/H_2 = 1$) at temperatures from 1600° to 1800°F and at pressures from 14.6 to 35 atmospheres in a thermobalance to determine their comparative reactivities. The test results were analyzed by two methods - the first developed at the Institute of Gas Technology (IGT) and the second suggested recently by Mahajan, et al. In the IGT method, gasification rate is correlated with two parameters - a surface area term and a surface reactivity term. In the second method, the time required for 50% base carbon conversion, $tau_{0.5}$ is proposed as a parameter to characterize gasification reactivity. Both methods showed that the reactivity of the chars from Sample B was higher compared to chars from Sample A. Within the constraints of the available data, the higher reactivity of Sample B could be attributed to its lower carbon content and higher ash content as compared to Sample A. In addition, the harder and apparently low-porosity char derived from Sample A, compared to Sample B, could partly explain this difference in reactivity.

8028 **Recent developments in high-temperature fluidization at the ash-agglomeration pilot plant.** Sandstrom, W.A.; Vora, M.K.; Rehmat, A.G. Chicago, IL; Institute of Gas Technology (1979). 14p. (CONF-791108—11).

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

This paper concentrates on the ash-agglomerating performance of the IGT fluidized-bed U-GAS pilot plant. Important new data are introduced on operations with ROM and washed Western Kentucky No. 9 coal covering fluidized-bed ash content, cyclones employed and fines returned. All test work has been conducted in a pilot plant reactor which is 3-foot (0.91 m) inside diameter and 25-foot (7.62 m) high. This reactor has recently been operated at pressures to 4 atmospheres (405 kPa) and temperatures to 1900°F (1038°C) during recent tests with Western Kentucky No. 9 bituminous coal. Currently, gasification tests are underway to further investigate process applicability to all US coals.

8029 **Design considerations for an in situ gasification test of eastern bituminous coals.** Strickland, L.D.; Martin, J.W.; Liberatore, A.J. (US Dep of Energy, Morgantown Energy Res Cent, WVa). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 355-365(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Underground of "In-Situ" coal gasification is now being evaluated with renewed interest in the U.S. as an alternative energy source. Huge reserves of unminable coal could be converted safely to a convenient from of fuel through this technology. Many unknowns face any designer of a research project test apparatus due to the research nature of the problem. In-Situ gasification is no exception and, in fact, the "in-situ" nature of the problem introduces many unique unknowns not normally encountered in designing test programs. The unique problems encountered in designing this test system, adopted solutions and preliminary design data are discussed. A test has been planned by the Morgantown Energy Research Center to evaluate this technology for the eastern bituminous coals.

8030 **Synthane--a process for the gasification of caking and noncaking coals.** Weiss, A.J. (C-E Lummus, Bloomfield, NJ). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 414-421(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Gasification of subbituminous Montana Rosebud and Illinois No. 6 coals has been accomplished at the Department of Energy's Synthane Pilot Plant in Bruceton, Pa. The Synthane process has been developed for the purpose of producing pipeline quality gas from coal. Gasification of Illinois No. 6 coal, a caking coal with a free swelling index (FSI) of 3.0-5.0, was demonstrated during the spring of 1978. This operation became possible after this coal was pretreated and FSI reduced to a value of o. The sequential pretreatment and gasification at a pressure of 600 psig is a specific feature of the Synthane process. The operating temperature of the pretreater was held at a temperature range of 750-800°F and in the gasifier at a temperature range of 1400-1550°F. The operating data obtained

from the runs with caking and noncaking coals are reported and analyzed.

8031 Process development for the westinghouse advanced fluidized-bed coal gasification system. Salvador, L.A.; Cherish, P.; Margaritis, P.J.; Rath, L.K. (Westinghouse Electr Corp, Madison, Pa). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 422-430(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The paper reports on the development of an advanced fluidized bed coal gasification process for low-Btu gas. The major emphasis on the program has been the operation of the 14,000 kg/d process development unit (PDU) which contains the main subsystems of the gasification process, the devolatilizer, which decakes and devolatilizes the coal, and the gasifier, which consumes the char produced in the devolatilizer and agglomerates the ash. The feasibility of the devolatilizer was demonstrated in 1976 with a variety of coals including highly caking eastern bituminous coals. During 1977 and 1978, the feasibility of the gasifier reactor was demonstrated in a series of highly successful tests run for a cumulative time of 1500 hours at design conditions of nominally 1038$degree$C and 1550 kPa. Techniques for routine operation of the reactor were established, and stable, controlled combustion, gasification, and agglomeration were achieved with a number of char and coal feedstocks fed directly to the unit without devolatilization or pretreatment.

8032 Gasification of coal liquefaction residues. Robin, A.M.; Schlinger, W.G. (Texaco Inc, South El Monte, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 431-437(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Several coal liquefaction processes are in advanced stages of development. Most of them requre hydrogen to liquefy the coal. In order to obtain a favorable product mix in such a plant, it is desirable to produce the needed hydrogen primarily from the non-liquefied fraction of the coal. This material, together with the inorganic ash and some fraction of the converted coal, may be recovered from many coal liquefaction processes as a pumpable residue at elevated temperatures. Large scale pilot plant runs have been completed at Texaco's Montebello Research Laboratory to demonstrate the efficient gasification of a variety of high ash containing coal liquefaction residues. A description of the process and equipment, material properties, and material balances for typical runs are included.

8033 Cleaning producer gas from the MERC gasifier. Moore, A.S.; Pater, K.; Rai, C.; Belt, R.J. (Dep of Energy, Morgantown Energy Res Cent, WVa). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 443-449(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The Morgantown Energy Research Center (MERC) of the Department of Energy is developing a system to clean low-Btu gas made from coal. The gas is generated in a prototype pressurized stirred fixed-bed gas producer developed in earlier work at MERC that gasifies 909 Kg/hr of caking bituminous coal. The objective is to clean the gas to the degree needed both by any end-use system consuming the gas, and to ensure that effluents from the end-use system meet emission requirements. This report describes pilot-scale development of a prototype gas cleanup system using a sidestream portion of the full 4,248,000 lit/hr gas output from the MERC gas producer. Subsequent activity to design, install and test a prototype full-flow gas cleanup system is also described. Specifically covered in this report are a series three other pilot-scale tests to develop a sidestream gas cleaning system to remove particles, tars, light oils, and alkali metals.

8034 Design of solids handling elements of a pressurized fixed bed coal gasifier. Csamer, R.P. (US Dep of Energy, Morgantown Energy Res Cent, WVa). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 581-585(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The Morgantown Energy Research Center has designed, developed, and installed several novel solids handling elements associated with the pressurized fixed-bed gasifier. The elements have been performance validated by considerable operational experience, functioning at gasifier pressures up to 17.5 kg/cm$_2$ and with feed stocks ranging from anthracite through the gamut of bituminous coals. The first described is a series of systems used to introduce and meter coal into a pressurized coal gasifier. Related is the design of a low speed, moderate temperature, "dirty" environment, rotary coal feed screw seal. Another development is a unique, compact, variable speed, high torque grate drive incorporating hydraulic rotary torque actuators and control components. the pertinent history of the development, important features of each element, and how they lend themselves to automated control of a gasifier are presented in detail.

8035 Low-BTu gas from the IGT ash-agglomeration gasification process. Rehmat, A.; Vora, M.K.; Sandstrom, W.A. (Inst of Gas Technol, Chicago, Ill). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 622-627(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Currently, the Institue of Gas Technology operates a single-stage, fluidized-bed coal gasification pilot plant which produces low-Btu gas. A prime objective has been to achieve up to 95% carbon conversion through selective removal of high-ash-bearing material. Tests conducted at atmospheric pressure to date indicate the process can achieve 90% carbon conversions. Work to produce medium-Btu gas through operation at 50 psig is scheduled. High-pressure (20 atm) test work is needed to determine the design factors for combined-cycle power plant usage.

8036 Catalytic gasification predevelopment research. Nahas, N.C.; Gallagher, J.E. Jr. (Exxon Res and Eng Co). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 2143-2147(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Significant progress has been made in the predevelopment research phase of catalytic coal gasification for the production of substitute natural gas (SNG). The potassium catalyst and the processing sequence permit the direct reaction of steam and coal to form methane and carbon dioxide, a reaction which is thermally neutral and does not require oxygen for heat balance or downstream methanation of synthesis gas. A model of the reaction kinetics has been developed and a preferred approach has ben identified to recover about 90 percent of the potassium catalyst for reuse.

8037 Catalytic coal gasification exploratory research program. Woodcock, K.E. (US Dep of Energy, Washington, DC). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 2148-2152(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Many inorganic salts are known to interact with the reactions of carbonaceous materials and steam, hydrogen, oxygen or carbon dioxide. Reaction rates can be increased significantly under some conditions and product gas compositions can be affected. Preliminary engineering and economic analyses based upon existing data indicate that processes employing additives to "catalyze" the coal gasification reactions may offer economic incentives over other process alternatives. Laboratory and engineering studies have been undertaken to further assess the potential of "catalytic" coal gasification processses.

LIQUEFACTION

REFER ALSO TO CITATION(S) 8008, 8013, 8016, 8017, 8021, 8024, 8025, 8032

8038 (FE—2566-27) **Upgrading of coal liquids. Hydrotreating and reforming SRC II process derived naphtha. Interim report.** Riedl, F.J.; DeRosset, A.J. (UOP, Inc., Des Plaines, IL (USA). Corporate Research Center). Jun 1979. Contract EF-77-C-01-2566. 26p. Dep. NTIS, PC A03/MF A01.

Solvent Refined Coal II (SRC II) process naphtha has been refined in UOP research pilot plants to 100 octane fuel by conventional refinery processing using commercial UOP catalysts. The naphtha is principally comprised of cyclic hydrocarbons. In addition, it contains over 9% phenols and heterocyclic structures, such as pyridines and thiophenes. Hydrotreatment was effective in reducing the sulfur and nitrogen to levels acceptable for reforming. Conditions used were substantially more severe than required to clean up a Middle East naphtha. However, they were well within commercial practice for hydrotreating heavier petroleum distillates. Reforming the hydrotreated SRC II naphtha produced 88 vol % of 99.9 octane (RON) gasoline. Conditions were relatively mild due to the predominance of cyclic structures in the feed. Dehydrogenation of naphthenes to aromatics was the principal reaction. The reforming operation yielded 1550 SCF/bbl hydrogen, about three times the amount needed for naphtha hydrotreatment.

8039 (FE—2893-30) **EDS coal liquefaction process development: Phase IV. Monthly technical progress report, April 1-April 30, 1979.** Epperly, W.R. (Exxon Research and Engineering Co., Florham Park, NJ (USA)). May 1979. Contract EF-77-A-01-2893. 64p. Dep. NTIS (US Sales Only), PC A04/MF A01.

The process variable study with Pittsburgh seam coals from the Ireland mine in West Virginia was continued in the 50 pound-per-day Recycle Coal Liquefaction Unit (RCLU-1). Preliminary results show that at the same condition, conversion of the present Ireland coal is higher than that for the Ireland coal studied during the first quarter of 1978. Bottoms recycle operations continued on the one ton-per-day Coal Liquefaction Pilot Plant (CLPP). Pilot

plant hydrotreating studies with Illinois (Monterey mine) and Wyoming (Wyodak mine) fuel oil blends were completed. Data workup on bench-scale extraction experiments to remove phenolics from EDS naphtha was completed. A minigasifier is being used to obtain coke gasification data for kinetic modeling in the EDS FLEXICOKING process development program. Elemental balances were completed for six modes of plant operation, each at start-of-run and end-of-run conditions, and heating values were determined for the various product streams. Engineering and procurement for ECLP of was approximately 92% complete at the end of April, some 3% (5 weeks) behind our original target of 95%. The cost outlook for ECLP as of 30 April was 107.6M$. ECLP construction was 49% complete at the end of April, approximately 21% or 3 months behind our original plan.

8040 (FE—3048-2) **Molten alkali metal hydroxide catalyzed coal liquefaction. Quarterly technical progress report, January-March 1979.** Skowronski, R.P.; Heredy, L.A. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Apr 1979. Contract ET-78-C-01-3048. 37p. Dep. NTIS, PC A03/MF A01.

This is the second quarterly report on the investigation of a molten alkali metal hydroxide catalyzed coal liquefaction concept. The objective of this project is to examine experimentally the conversion of coal to nonpolluting liquid fuels by molten alkali metal hydroxide catalyzed hydrogenation. The approach will emphasize maximizing liquid yields, with particular emphasis on distillate liquids, maximizing heteroatom removal, and minimizing gas production and hydrogen consumption. This effort consists of a laboratory test program to evaluate coal feedstocks, determine the effects of eight operating parameters on the production of liquids, and evaluate potential materials of construction. The most important achievement during this quarter was the demonstration that a 35 wt % oil yield (42% on a no-loss basis) can be obtained using molten alkali metal hydroxide catalyzed hydrogenation. This is an excellent liquid yield which was obtained despite the fact that the operating conditions have not been optimized. It is believed that an even higher liquid yield can be obtained under optimum conditions. The analytical data reveal a number of correlations from the experiments that have been conducted. Under the conditions tested: NaOH is a better catalyst than KOH, both in terms of a higher liquid yield and a lower gas yield (NaOH is also less expensive than KOH); the Illinois No. 6 coal gave the highest liquid yield of the three coals tested; and mass tranfer apparently plays an important role in molten alkali metal catalyzed coal hydrogenation. Liquid yield increases and gas yield decreases with increased agitation rate.

8041 **Exploratory research in coal conversion.** Wender, I.; Friedman, S. (US Dep of Energy, Pittsburgh Energy Res Cent, Pa). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 457-462(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Coal can be degraded to low molecular weight soluble materials by reductive alkylation under very mild conditions. During this reaction ethers are cleaved and the coal is reduced and alkylated. Included in this paper is recent work on the mechanism of hydrogen transfer from donor molecules in coal liquefaction, liquefaction of coal with CO (or synthesis gas) and water (COSTEAM reaction), and the use of disposable catalysts in liquefaction. Supercritical gas extraction of coal, now in the pilot plant stage, is discussed. Of a number of processes dealing with the precombustion removal of sulfur by chemical methods, one of the most promising uses only air and water and removes significant amounts of organic sulfur. Micron-sized powdered coal, suspended in liquid fuels, is a promising extender for scarce diesel and fuel oils.

8042 **Design study for a coal/oil slurry pumping and preheating system.** Fein, H.L.; Parekh, R.D.; Larosa, P.J. (Thompson Ramo Wooldridge, Inc, Syst Plann Div, McLean, Va). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 592-601(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

This study develops a baseline conceptual design for a coal/oil slurry mixing, pumping, and preheating system for a 25,000 tpd coal liquefaction plant. The baseline system utilizes six process trains and one spare, with each train consisting of two slurry mix tanks, two recirculation pumps, two charge pumps, one preheater, and one heat recovery steam generator. The preheaters are designed for two parallel passes and each delivers 311 MM Btu/h at an overall average flux of 5.981 Btu/ft^2, hr. The installed cost for the baseline system is $211 million, with 96 percent of this cost attributable to the preheater and flue gas heat recovery systems. Potential design modifications have been identified that might significantly reduce this cost.

PYROLYSIS AND CRACKING

REFER ALSO TO CITATION(S) 8739

BY-PRODUCTS

REFER ALSO TO CITATION(S) 8937

PROPERTIES

REFER ALSO TO CITATION(S) 8013, 8019, 8020

8043 (CONF-7906126—(Summ.)) **Transactions of the conference on thermodynamics research requirements on fossil fuel processes. Final report.** (Science Applications, Inc., East Brunswick, NJ (USA)). Oct 1979. Contract AT21-78MC08333. 54p. Dep. NTIS, PC A04/MF A01.

From Conference on thermodynamics research requirements on fossil fuel processes; Tulsa, OK, USA (20 Jun 1979).

The meeting discussed the requirements of thermodynamics properties and analytical characterization methods needed for materials encountered in fossil fuel conversion processes. (LTN)

8044 **On line monitoring of major ash elements in coal conversion processes.** Stewart, R.F.; Hall, A.W. (US Dep of Energy, Morgantown Energy Res Cent, WVa). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 586-591(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A prompt nuclear method is described for monitoring the major ash elements in coal moving at high tonnage flow rates. Most of the elements in coal including Fe, Al, Si, S, Na, K, Ca, Cl, N and Ti can be continuously monitored within 0.1% accuraacy when they vary in concentration from 0.1 to 10% of the raw coal. Possible applications in coal conversion processes are outlined to provide process control that should improve the efficiency and reliability of coal use.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 8061

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 8016, 8055, 8061, 8699, 9062, 9218, 9264, 9328

8045 (COO—2758-6) **Strip mine reclamation: criteria and methods for measurement of revegetation success. Progress report, April 1, 1979-March 31, 1980.** Carrel, J.E.; Kucera, C.L.; Johannsen, C.J.; Blanchar, R.W. (Missouri Univ., Columbia (USA)). Dec 1979. Contract EY-76-S-02-2758. 32p. Dep. NTIS, PC A03/MF A01.

During this contract period, research aimed at finding suitable methods and criteria for determining the success of revegetation in Midwestern surface coal mines was initiated. Particularly important to the experimental design was the concept of reference areas, sites from which the performance standards for reclaimed areas are to be derived. Because permanent rules and regulations for Public Law 95-87, the Surface Mine Control and Reclamation Act, were not yet promulgated, direct and remote sensing techniques for measuring plant ground cover, productivity, and species diversity were tested in 9 mine and 3 reference sites. At the same time it was arranged with 4 mine operators and state regulatory officials to begin working early in 1980 in about 12 matched pairs of mine and reference sites permitted under the new surface mine regulations. Data gathered in the 1979 growing season show that most unmanaged mineland pastures had lower average ground cover and production than reference pastures. No two sites, not even any reference areas, had plant species similarity indices greater than 75%. Remote sensing by digital computer image analysis of color infrared aerial photographs, when compared to ground level measurements, is a fast, relatively inexpensive way to determine plant ground cover and possibly biomass yields. But a remote sensing approach is inferior to standard surface methods when a detailed description of plant species is needed.

8046 **Coal conversion technologies: some health and environmental effects.** Morris, S.C.; Moskowitz, P.D.; Sevian, W.A.; Silberstein, S.; Hamilton, L.D. (Brookhaven National Lab., Upton, NY). *Science;* **206**: 654-662(9 Nov 1979).

Several technologies to convert coal to liquid and gaseous fuels are being developed in the United States, some with support from the Department of Energy. Substitution of these technologies for those currently being used will produce different health and environmental hazards. In this article, selected health and environmental effects of four coal conversion and four existing technologies

are compared. For each technology, the emission estimates for complete fuel cycles, including all steps in fuel use from extraction to the end use of space and water heating by electricity or direct combustion, were prepared by means of the Brookhaven Energy System Network Simulator model. Quantitative occupational health and safety estimates are presented for the extraction, transportation, distribution, processing, and conversion activities associated with each technology; also included are some public health damage estimates arising from fuel transportation and air pollution impacts. Qualitative estimates of health damage due to polycyclic organic matter and reduced sulfur are discussed. In general, energy inefficiencies, environmental residuals, and hence implied environmental effects and health damage increase in the order: (1) direct combustion of natural gas and oil; (2) direct combustion of synthetic gas and oil; (3) central-station electric power produced from synthetic gas; (4) central-station electric power produced from coal; and (5) central-station electric power produced by the combustion of synthetic liquid fuels. The compliance and conflict of these technologies with the amendments of the Clean Air Act and other legislation are discussed.

RESERVES AND EXPLORATION

8047 (FE—8881-1) **Development and testing of a microwave system to measure coal layer thickness up to 25 cm.** Roe, K.C.; Ellerbruch, D.A. (National Bureau of Standards, Boulder, CO (USA). Electromagnetic Fields Div.). Jan 1979. Contract ET-77-I-01-8881. 27p. (SR—723-8-79). Dep. NTIS, PC A03/MF A01.

This report describes the design, construction, and testing of a microwave coal thickness indicator built to demonstrate the hypothesis that an electromagnetic coal interface detector (EMCID) corrected for surface admittance variation can measure coal thickness up to 25 cm within +- 10 percent accuracy. The design is based upon the FM-CW radar technique where reflections from layered strata are detected in time relationship to propagation path lengths. Relative depths to layered strata are displayed in numerical digits. Determining the thickness of the coal layer left on mine-haulageway roofs is important for both mine safety and maximum coal recovery. A specified thickness is required in many mines to maintain roof-strength and to prevent exposure of the overlying slate or shale to air, which deteriorates slate and shale.

MINING

REFER ALSO TO CITATION(S) 8053, 8054, 8699

8048 (BM-RI—8402) **Geology of the single-entry project at Sunnyside Coal Mines 1 and 2, Sunnyside, Utah.** Scheibner, B.J. (Bureau of Mines, Washington, DC (USA)). 1979. 106p. US Dept. of Interior, Washington, DC.

This Bureau of Mines report describes the geology and physical properties of core samples at the Sunnyside coal mine No. 1, Sunnyside, Utah, and was written in conjunction with the Single-Entry Program conducted at the mine. The objective of this program was to test the hypothesis that the single-entry system in the Sunnyside mine, supported in the center by open cribs and divided by a fire-resistant partition, is equivalent to or better than a two-entry system. Drill cores, taken underground at 15 sites in the single-entry study area, facilitated the construction of geologic cross sections of the entries. Physical property data obtained from the drill cores was used in a three-dimensional finite element analysis program to evaluate the stability of the openings, the support requirements, and the deformation characteristics of the roof and floor material. Data on 10 physical property parameters for 5 rock types plus coal are also tabulated and discussed.

8049 **Sheridan County, Wyoming.** Porter, F.H.; Grasso, D.N. Laramie, Wyoming; Geological Survey of Wyoming (1978). vp. (NP—24120).

Detailed information is contained in this packet on geology, petroleum, coal, minerals, water resources, stratigraphy, land use, landforms, and vegetation by way of maps, charts, tables, diagrams, and pictorials for Sheridan County, Wyoming. Additionally, announcement is made of the availability of 1518 topographic maps distributed by the Geological Survey for the state of Wyoming. (MCW)

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 8042, 8781

8050 (ANL/CNSV-TM—21) **Analysis of a coal brokerage for a midwest site.** Knorr, R.; Wilkie, K. (Argonne National Lab., IL (USA)). 1 Oct 1979. Contract W-31-109-ENG-38. 47p. Dep. NTIS, PC A03/MF A01.

Coal demand of an area aggregated and served through a single facility in order to achieve the high volumes necessary to justify unit-train service is deemed a coal brokerage. Once such a system is initiated, it is conjectured that coal users too small to individually receive unit-train orders can begin to capture the cost savings associated with large volume shipments. In order to examine the coal-brokerage concept closely, the Green Bay-Kewaunee, Wisconsin region was chosen as the site for analysis because: (1) there had been speculation by lower peninsula Michigan utilities concerning a Wisconsin transshipment site for western coal; (2) the area's paper industry is a large coal user; (3) the Wisconsin Energy Office has researched coal consumption in depth, and has an available data base for industrial boilers and their fuel type; (4) line-haul rail routes allow for adequate access from western mines to utility and industrial coal users; and (5) there is no single user or facility currently large enough to handle unit-train shipments. Details on planning and design decisions for a coal brokerage are presented. (MCW)

8051 (COO—4935-2) **Transportation of coal by hydraulic container pipeline (HCP): a feasibility study.** Liu, H.; Assadollahbaik, M.; Yang, J.C. (Missouri Univ., Columbia (USA). Dept. of Civil Engineering). May 1979. Contract EM-78-S-02-4935. 71p. Dep. NTIS, PC A04/MF A01.

The purpose of this sponsored research is to assess the feasibility and the potential value of HCP (Hydraulic Container Pipeline) as a new mode of freight transport. The tasks of the study involve (1) assessment of the energy conservation value of HCP as compared to other modes of freight transport such as truck, rail and slurry pipeline, (2) assessment of the market of HCP for coal transportation, (3) development of design concepts on HCP system for transporting coal, and (4) design and construction of a small HCP system for the demonstration of the concept of HCP transportation. To date, the first three of the four aforementioned tasks have been completed; task 4 has just begun. This report deals with tasks 2 and 3. Another report, entitled Energy Conservation Value of Hydraulic Container Pipeline (HCP), deals with task 1. It is shown in this report that a large market exists for HCP to transport coal. Not only is HCP the most environmentally and socially acceptable way to transport coal, it can also compete effectively with truck, train and even slurry pipeline on economic grounds.

8052 (FE—3242-2) **Laminar flow cyclone development program. Quarterly technical progress report, October 1-December 31, 1978.** Giles, W.B.; Bekofske, K.L. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Jan 1979. Contract ET-78-C-01-3242. 9p. Dep. NTIS, PC A02/MF A01.

The objective of this exploratory investigation is to attempt to eliminate the deleterious effects of turbulent mixing in the cyclone separation process. Transition from laminar to turbulent flow normally occurs at low Reynolds number. However, it is known that this transition can be delayed to higher velocities and large scale by suppressing inlet turbulence and preventing boundary layer tripping. Extended laminarization can also be obtained by techniques such as wall suction and wall cooling (in the case of gaseous flows). In cyclone separators, the flow must be set into a swirling motion to provide the separative g-field. The present implications are that the flow entering the cyclone is highly unstable and that the swirl vane-wake turbulence is the most probable trigger. Experimentally, the best course of action appears to design a model with greater contraction to suppress vane-wake turbulence and a shorter radial inflow region to inhibit the development of the wall jet. As a means to better understand these phenomena an analysis of the present boundary layer situation is desirable and will be attempted.

8053 (FE—9013-1) **Demonstration of shortwall face conveyor. Volume I. Final technical report, 1 May 1979.** Stine, D.C. (Joy Mfg. Co., Franklin, PA (USA)). 1 May 1979. Contract ET-75-C-01-9013. 91p. Dep. NTIS, PC A05/MF A01.

This document describes the development, installation, and demonstration of a continuous haulage system operated on a shortwall mining panel at Valley Camp Coal Company's Number 3 Mine located near Triadelphia, West Virginia. This system includes a Joy Shortwall Face Conveyor and a roof hung Joy Monorail Transfer Conveyor. The conveyors were operated in conjunction with a Joy 14BU10 Loader, a Joy 12CM5-8AX Continuous Miner and thirty-nine Joy 4-Leg 500 Ton Shortwall Roof Supports. A reworked Joy 3JCM Continuous Miner (crawler frame and power unit only) was also used during the demonstration period. Downtime data indicate very few problems were encountered with the monorail conveyor. Major problems did occur with the face conveyor connecting pins, slippage of the conveyor chain on the drive sprocket, inability to keep the conveyor pans in line which caused flights to be broken, chain elongation, and repositioning of the face conveyor to assure safe passageways for the roof support operator. A total of sixty-eight shifts were worked using the monorail and face conveyor combination and 8805 tons of clean coal were produced at 35% reject. This averaged out to one hundred and thirty (130) tons of

coal per shift. Production achieved using the face conveyor and the 18SC Shuttle Car totaled 23,590 tons. This was mined in a total of one hundred and sixteen shifts with an average of two hundred and three tons per shift.

8054 (FE—9029-1) **Development of a conveyor train haulage system. Final technical report, April 1979.** Ciavatta, A.; Kellinger, G.; Klatchko, G. (Ingersoll-Rand Research, Inc., Princeton, NJ (USA)). Apr 1979. Contract ET-76-C-01-9029. 155p. Dep. NTIS, PC A08/MF A01.

The inherent variability of seam height, coal hardness, mine conditions, equipment and man's knowledge constitutes a significant impediment to the realization of a truly continuous process from face to surface. In an effort to expand and improve one link in the chain, several preliminary design studies were completed and it was determined that a passive ground system approach was undesirable from a cost and engineering perspective. The recommended approach for a continuous face haulage unit was a mobile feeder breaker as lead vehicle and in series with it would be a multiple array of 19'9" belt conveyors separately powered in a cascade series supported by a monorail. The last of the series of conveyor cars was a transverse conveyor that discharged in a 180 degree pattern. Each conveyor is separately powered. The economics revealed that in a 2.4 MTPY mine the internal rate of return after taxes was 21.65% as opposed to 17.43% for a comparable shuttle car system. The computer analysis on efficiencies showed improvements of 21% on a 6' seam to 45% improvement on a 3' seam.

8055 (FE/EES—79/12) **Transportation of a premium coal fines product.** Campbell, T.C. (Department of Energy, Morgantown, WV (USA). Process Evaluation Office). Jul 1979. 8p. Dep. NTIS, PC A02/MF A01.

One result of the current interest in the use of coal to reduce dependence on imported oil has been the development of chemical coal cleaning processes. Studies of the TRW Meyers Gravichem and the Pittsburgh Energy Technology Center's Oxydesulfurization processes made at the Process Evaluation Office of the Department of Energy indicated that transported and material handling problems associated with the fine coal product from the processes might be important factors in the product cost. If the desulfurization occurs near the mine or mines, the product must be moved to the consumer as a fine coal product, 14 mesh x 0; if it occurs near the point of consumption, the coal will be shipped in the raw lump form. Advantages and disadvantages of choosing one site over the other are considered, and some of the transportation problems that will be encountered are identified and examined.

8056 (ARC—77-202/CO-5896(Vol.2)(App.)) **Applicability of coal slurry pipelines to the Appalachian Region. Volume II (Appendices). Final report.** Fallah, M.H.; Ciliano, R. (Mathtech, Inc., Princeton, NJ (USA)). Sep 1978. 163p. Appalachian Regional Commission, Washington, DC.

8057 (ARC—77-202/CO-5890(Vol.1)) **Applicability of coal slurry pipelines to the Appalachian Region. Final report.** Fallah, M.H.; Cilicano, R. (Mathtech, Inc., Princeton, NJ (USA)). Sep 1978. 141p. Appalachian Regional Commission, Washington, DC.

The Appalachian Region, with its vast coal resources, has a critical role in meeting national energy goals. Coal production in Appalachia is expected to increase substantially by 1985. The increased demand for Applachian coal, however, could put severe pressure on the existing transportation systems in the region. The Appalachian Regional Commission (ARC) in its role as coordinator for local and state authorities within the region contracted with Mathtech, Inc., to assess the applicability of coal slurry pipelines to the Appalachian Region. The study focused on the coal flow network in Appalachia. The coal flows with potential for slurry pipeline applications were then analyzed in a series of case studies using coal demand projections for 1990. For each case study, the cost of coal transportation by a slurry pipeline was determined and compared to that of the competing modes. These case studies indicated that coal slurry pipelines are economically viable for Appalachia only in specific cases. The socioeconomic and environmental implications of coal slurry pipelines for the Appalachian Region were analyzed within the context of the highly probable applications.

COMBUSTION

REFER ALSO TO CITATION(S) 8014, 8435, 8733, 8739, 8996

8058 (EPRI-FP—1164) **Coal-water slurry systems for oil-design power plants. Final report.** Glenn, R.D.; Rhodes, A.W. (Combustion Processes, Inc., New York (USA)). Sep 1979. 64p. Dep. NTIS, PC A04/MF A01.

This study is a preliminary exploration of the feasibility of producing a slurry of pulverized cleaned coal in water and burning it in boilers designed for fuel oil combustion. The objective of this proposed system is the substitution of coal for oil at some existing power plants. The goals of this study were to review and assess the status of technology for each element of the system, to consider costs in a preliminary way and to suggest areas where additional technical efforts might be advantageous. Cost comparisons based on current fuel prices are generally favorable for coal-water slurries produced from coal that has been mechanically cleaned to less than 3% ash. Further processing of coal with chemical reagents to reduce its sulfur and ash content (possibly achieving $< 0.5\%$ ash) is technically feasible; however, the economics of the available processes is prohibitive. There are three different laboratories, each using a different approach, that have produced small quantities of slurries containing 70% of pulverized (minus 200 mesh) coal in water. It is recommended that larger quantities of slurry be produced promptly to supply material for commercial scale burner development tests.

8059 **Fluidized-bed combustion of low-quality fuels.** Mei, J.S.; Grimm, U.; Halow, J.S. (US Dep of Energy, Morgantown Energy Res Cent, WVa). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 494-499(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The paper reports on a study that is evaluating the application of fluidized-bed combustion to utilize low-quality fuels including anthracite refuse, sub-bituminous coal, lignite and lignite washery refuse. During the combustion tests, carbon combustion efficiencies from 70 to 99 percent were achieved. Calcium in the ash of subbituminous and lignite fuels was found to be effective in sulfur capture allowing low sorbent additions to meet EPA SO_2 limits. Anthracite refuse required higher sorbent addition rates than all fuels tested. No/sub x/ limits were easily met. Several fuel specific operating problems and solutions to these problems were identified during the tests.

8060 **Eductor performance in the coal feed system of a fluidized-bed combustor.** Roth, L.P.; Divilio, R.J.; Reed, R.R. (Pope, Evans and Robinson Inc, Alexandria, Va). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 617-621(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A study of the potential use of an eductor in the coal feed system of a 9 ft^2 pilot plant fluidized-bed combustor was performed. Experimental runs were performed over wide ranges of minimum nozzle diameters, eductor inlet pressures, air flow rates and back pressures. These data correlated well with a semiempirical model. The use of these equations in the design of the coal feed system of fluidized-bed boilers is presented.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 8701

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 8046, 9337

8061 **Reduced toxicity of an aqueous coal-conversion effluent following waste disposal treatment.** Schultz, T.W.; Perry, S.T.; Dumont, J.N. (Oak Ridge National Lab., TN). *Bull. Environ. Contam. Toxicol.;* **20**: 633-639(1978).

Since the aqueous effluent from a single commercial conversion plant may range from 0.4 to 1.2 million gallons per day and contain hundreds or thousands of different compounds, it is essential to examine such effluents as potential environmental hazards. One of the more promising coal-conversion schemes is the Solvent Refined Coal (SRC) process which can produce fuel low in sulfur and ash from coals high in these substances. Chemical analyses of the untreated waste process-liquid stream from the SRC plant (Fort Lewis, Washington) show that it has a high pH and contains high concentrations of sulfur, phenol, and cresols in addition to process maphtha. This waste process-liquid stream, however, is fed through a waste-water-oil disposal system which includes a bio-reactor unit and sand and carbon filters. The liquid waste effluent from this water-oil disposal system has a nearly neutral pH and a greatly reduced sulfur and phenol content. The purpose of the present report is to examine the biological effects of the liquid effluent stream from the oxycontact bio-reactor unit on a model system - the ciliate Tetrahymena pyriformis. This model system has been used to examine the toxicity of untreated process streams and pure compounds from a variety of coal-conversion processes.

REGULATIONS

REFER ALSO TO CITATION(S) 8670, 8671, 8672, 8673, 8674, 8675, 8676, 8677, 8698, 8701

8062 (CONF-791009—13) **Increased coal use: the need for strategies to reduce local and regional conflicts.** Surles, T.; Hoover, L.J.; Goldberg, A.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The analysis indicates that energy use management strategies need to be developed to ensure that local and regional conflicts emerging from the increased use of coal can be resolved with minimum adverse environmental, economic, and societal impacts. The major deterrent to reaching increased coal use goals, which are 160 GWe of new utility coal use and 4.5 Quads of new industrial coal use, appears to be the adulteration of air quality. Siting of utility and industrial sources in or near nonattainment areas or Prevention of Significant Deterioration (PSD) Class I or Class II areas may be constrained. 35% of new utility coal use may be inhibited in urban areas due to nonattainment provisions of the CAA. These problems are predicted to be most pronounced in the Northeast and Midwest. Increased coal use should not cause increased public heatlh impacts. Although it is difficult to quantitate the anticipated health impacts with a high degree of certainty, relationships can be assumed between ambient atmospheric sulfate levels and adverse health effects. The major impact from coal use will arise in areas downwind from areas projected to be subject to increased energy production. These impacted areas are primarily located in the northeastern quadrant of the United States. In the western United States, long-range transport of sulfur dioxide or sulfates (SO_4) does not appear to constrain coal use on a regional level.Water quality and water availability constraints on site-specific bases are expected. Solid waste does not appear to moderate the achievement of increased coal use goals, particularly in the utility sector and, to a lesser extent, the coal extraction sector. It may, however, severely restrict increased coal use goals for industry, especially in the urban areas of the Midwest and Northeast, where a lack of suitable nearly solid waste disposal sites could result in high transportation costs.

PETROLEUM

REFER ALSO TO CITATION(S) 8000, 8663

8063 **Guide to North Sea Oil and Gas Technology.** London, England; Institute of Petroleum (1978). 195p. (CONF-7711134—).

From Annual conference of the Institute of Petroleum; London, UK (Nov 1977).

Nineteen papers are included, arranged under the following headings: exploration, production, transport and storage, and oil/gas ashore. Separate abstracts were prepared for the data base of all 19 papers. (DLC)

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 8120

8064 (METC—8214-T1) **Coordination of study of the Devonian black shale in the Illinois Basin (Illinois, Indiana, and Western Kentucky). Quarterly progress report, 1 August-31 October 1979.** Lineback, J.A. (Illinois State Geological Survey, Urbana (USA)). 5 Nov 1979. Contract EW-78-S-21-8214. 14p. Dep. NTIS, PC A02/MF A01.

Purpose is to develop a data base for the Devonian shale in the Illinois Basin. Progress on the ILLIMAP and on lithofacies maps is reported. (DLC)

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 8049, 8921, 8973

8065 (METC—5232-2) **Weeks Island S sand reservoir B gravity stable miscible CO_2 displacement, Iberia Parish, Louisiana. Second annual report, June 1978-June 1979.** Perry, G.E. (Shell Oil Co., Houston, TX (USA)). Nov 1979. Contract EF-77-C-05-5232. 94p. Dep. NTIS, PC A05/MF A01.

The second year results from CO_2 injection, downdip water production, logging procedures used to monitor flood front, and displacement observations are reported. Shell's Bellaire Research Center worked on the construction of a reservoir simulator which includes the effect of compositional behavior of the S Sand Reservoir B crude oil as it is contacted by CO_2 slug material.

8066 (SAN—1277-3) **200 Sand Steamflood Demonstration Project. Third annual report, June 1978-June 1979.** (Santa Fe Energy Co., Santa Fe Springs, CA (USA). Chanslor Div.). Nov 1979. Contract EY-76-C-03-1277. 50p. Dep. NTIS, PC A03/MF A01.

The project is testing an enhanced steamflooding technique in the Midway-Sunset Field, Kern County, California. The 200 Sand Pool made very little primary production and responded poorly to cyclic steam stimulation, so this project was initiated to demonstrate the operational, recovery, and economic aspects of steamflooding a typical heavy oil reservoir which had unfavorable response to cyclic steam stimulation. The test is being conducted in four (4) 2.35 acre inverted seven-spot steam drive patterns, which are not fully developed with producers. The reservoir contains approximately 50 million barrels of oil-in-place in an anticlinal structural feature between 400 and 700 feet in depth. 1.73 million bbl steam (350°F, 72% quality) have been injected since October 1975 into the four wells. Production has averaged 136 bbl/d oil and 276 bbl/d water.

8067 (SAN—2040-1) **Improved steam flooding by use of additives. Final report.** Kuuskraa, V.A.; Hammershaimb, E.C.; Doscher, T.M. (Lewin and Associates, Inc., Washington, DC (USA); University of Southern California, Los Angeles (USA)). Dec 1979. Contract ET-78-C-03-2040. 96p. Dep. NTIS, PC A05/MF A01.

The current level of interest in, need for, and development work in progress on additives for increasing the recovery of steam drive enhanced recovery are discussed. The report consists of the following chapters: summary and conclusions; the status of steam drive operations; the steam drive mechanism; results of the survey; significant findings from the literature/patent search; review of additives for increasing the recovery efficiency of steam drive; review of significant technical literature; review of significant patents; and report on site visits.

8068 (SAND—79-2091) **DEEP STEAM Project. Quarterly report for April 1-June 30, 1979.** Bader, B.E.; Fox, R.L.; Johnson, D.R.; Donaldson, A.B. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 14p. Dep. NTIS, PC A02/MF A01.

Objective of DEEP STEAM is to develop the technology required to economically produce heavy oil from reservoirs greater than 2500 feet in depth using steam injection. The technology includes: 1) methods of decreasing heat loss from injection strings and improving other well completion components and 2) development of downhole steam generation methods. Accomplishments during this reporting period were: evaluation of proposals for major research and development contract on thermal packers for DEEP STEAM operations; successful atmospheric testing of high pressure combustion chamber with indication of negligible soot production even under poor atomization conditions; site selection for the preliminary field test at Chevron Well 6 - 19 in Section 3 of Kern River Field, Bakersfield, CA; and low pressure reservoir simulation experiments using a freon gas as surrogate for high pressure carbon dioxide, which have produced recovery patterns similar to that predicted by computer simulation.

8069 **High conformance enhanced oil recovery process.** Varnon, J.E.; Schievelbein, V.H.; Kudchadker, M.V.; Whittington, L.E. (to Texaco, Inc.). US Patent 4,161,218. 17 Jul 1979. Filed date 22 Dec 1977. 10p.

The conformance of a water flood oil recovery process, including surfactant or other chemicalized water flood process, in a formation containing at least two of varying permeability, the permeability of one zone being at least 50 percent greater than the permeability of the other zone, is improved by flooding until the higher permeability zone has been depleted, after which a fluid is injected into the high permeability zone, said fluid having relatively low viscosity at the time of injection and containing surface active agents which promote the formation of a coarse emulsion in the flow channels of the formation which reduces the permeability of the high permeability zone. Since the viscosity of the fluid injected into the previously water flooded, high permeability zone is no greater than water, it is injected easily into the zone and moves through substantially the same flow channels as water would move in the formation. After the permeability of the first zone has been reduced substantially, water flooding may then be accomplished in the second zone which was originally not invaded by the injected fluid since its permeability was substantially less than the permeability of the first zone. The surface active agent is tailored to exhibit optimum emulsion formation properties with the particular aqueous fluid present in the flow channels of the formation to be treated. The optimum emulsifying surfactant comprises a mixture of an alkylpolyalkoxyalkylene sulfonate or an alkylarylpolyalkoxylalkylene sulfonate and an organic sulfonate such as petroleum sulfonate. 18 claims.

8070 Process for recovery of hydrocarbons. Riley, E.A. US Patent 4,161,047. 17 Jul 1979. Filed date 19 Oct 1977. 8p.

A process for the recovery of hydrocarbons from oil field reservoirs, wherein dry pipeline quality natural gas, essentially entirely methane, is injected, stored and recycled in the wells of the reservoir to effect a significant recovery of the oil in the reservoir while storing and holding the gas for ultimate use only after the oil has been recovered from the reservoir, whereby the relatively scarce gas is utilized to its maximum extent and oil is produced which would be otherwise difficult or uneconomical to produce by prior known processes. The process can be utilized in an oil reservoir at any stage of pressure depletion; but, is most uniquely applicable in oil reservoirs which are: (1) essentially depleted of primary energy, (2) reservoirs which have undergone successful secondary recovery processes (primarily water flooding), (3) reservoirs which have undergone unsuccessful secondary efforts due to adverse rock or fluid properties which caused premature breakthrough of injected or driving fluid, (4) in primary depleted reservoirs which are not considered as candidates for secondary recovery processes, or (5) reservoirs which have undergone tertiary recovery processes which have left substantial volumes (or percentage saturation) of oil in-place. 12 claims.

8071 Fluid dump mechanism. Hostrup, K.R. (to Halliburton Co.). US Patent 4,161,224. 17 Jul 1979. Filed date 10 Feb 1978. 8p.

Disclosed is an apparatus for controlling sliding movement between two telescoping members of a jar or like apparatus for use in an oil well. The telescopic sliding movement between the two members is controlled by a hydraulic impedance device which is bypassed by a hydraulic fluid dump valve after a predetermined amount of telescopic movement between the two members. A dump valve opening means is releasably attached to the walls of one of the members and, after opening the dump valve mechanism, releases from the member wall to move with the telescoping member holding the dump valve mechanism in the open condition. Means is also disclosed for recocking the apparatus and for returning the opening means to its initial position such that the opening means is reattached to the wall of said one member. 5 claims.

8072 Ball sealer diversion of matrix rate treatments of a well. Erbstoesser, S.R.; Muecke, T.W.; Cooke, C.E. Jr. (to Exxon Production Research Co.). US Patent 4,160,482. 10 Jul 1979. Filed date 12 Jun 1978. 16p.

A method for sequential treatment of formation strats when treating fluid is pumped into a well at a matrix rate by temporarily closing perforations in the well casing. The perforations are closed by ball sealers injected into the wall during the treatment. The ball sealers are sized to plug the perforations and have a density less than the density of the treating fluid. The treating fluid is injected at a rate which transports the ball sealers to the perforation but which is sufficiently low to prevent formation fracture. 17 claims.

8073 Method for recovering subsurface earth substances. Turk, L.J.; Kehle, R.O. (to HOP Corp.). US Patent 4,160,481. 10 Jul 1979. Filed date 7 Feb 1977. 12p.

This invention relates to novel leaching methods and apparatus for recovering minerals such as ores, high viscosity oil, and the like, from the subsurface earth formation. More specifically, the formation is penetrated by a plurality of mine shafts or large-diameter boreholes which are spaced apart as a function of the lithological characteristics of the formation. Thereafter, a suitable leaching fluid such as a liquid solvent, steam, free hydrogen, or carbon dioxide is injected into the formation through a plurality of drill holes radially extending from the lower portions of the shafts. 16 claims. In a particular technique for recovering high viscosity oil, the formation is initially subjected to a sequence of soaking cycles, wherein fluid is injected into the formation during separate discrete time periods, and wherein dissolved minerals or reduced viscosity oil is drained from the drill holes during the interval following each injection period. Thereafter, fluid is continually injected into some or all of the radials extending from selected ones of the shafts to sweep the formation, while dissolved ores or oil is drained from the remaining radials extending from the same or other shafts.

8074 Heavy oil recovery process. Richardson, R.D.; Shannon, R.H. US Patent 4,160,479. 10 Jul 1979. Filed date 24 Apr 1978. 16p.

A process incorporating integrated units and combined cycle energy production is provided for the recovery and upgrading of oil containing deposits which are not readily amenable to recovery and upgrading, to produce therefrom a light oil and elemental sulfur. Residual hydrocarbons generated in the process are gasified to produce hot gases which are used as a source of energy for process use, including electric power. The electric power is utilized to electrolyze water and produce hydrogen for use in upgrading and oxygen for use in gasification. The integration of gasification of residual hydrocarbons to produce, inter alia, electric power with the electrolysis of water to produce hydrogen for upgrading, and efficient use, distribution and recovery of energy in combined energy cycles provides an economical and essentially energy sufficient process with the flexibility to be adapted for the recovery and upgrading of various low yield oil deposits. 18 claims.

8075 High conformance oil recovery process. Schievelbein, V.H.; Park, J.H. (to Texaco Inc.). US Patent 4,160,480. 10 Jul 1979. Filed date 22 Dec 1977. 14p.

The conformance of an enhanced oil recovery process including waterflood, surfactant or other chemicalized water flood process, in a formation containing at least two strata or zones of varying permeability, the permeability of one zone being at least 50 percent greater than the permeability of the other zone, is improved by flooding until the higher permeability zone has been depleted, after which an aqueous fluid is injected into the high permeability zone, said fluid having relatively low viscosity at the time of injection and containing a particular surface active agent which promotes the formation of a coarse emulsion in the flow channels of the formation which reduces the permeability of the high permeability zone. After the permeability of the first zone has been reduced substantially, flooding may then be accomplished in the second zone which was originally not invaded by the injected oil recovery fluid since its permeability was substantially less than the permeability of the first zone. The surface active agents are individually tailored and the ratio of dissimilar surfactants balanced to exhibit optimum emulsion formation properties with the particular aqueous fluid present in the flow channels of the formation to be treated.

8076 Valve assembly for controlling liquid flow in a wellbore. Fournier, O.J. (to Dow Chemical Co.). US Patent 4,154,303. 15 May 1979. Filed date 13 Feb 1978. 6p.

The valve assembly disclosed herein is used primarily in oil or gas well servicing to prevent contamination of fluids used to treat the formation. The valve is coupled into a tubing string, and it includes a slidable hollow mandrel, with a hingable flapper disk positioned below the mandrel. The valve is generally used in cooperation with a packer tool and bridge plug. When treating fluid is pumped down the tubing string it pushes the flapper disk open and holds it open, so the fluid can reach the formation interval being treated. To treat the next higher interval the packer is unset to raise the tubing string. Releasing the packer allows residual fluids to backflow from the well casing annulus into the tubing string. In this tool the backflowing fluid closes the flapper, so that it acts as a check valve to prevent contamination of the treating fluid. Before the valve is pulled out of the casing the mandrel is slid downwardly, to push the flapper open and hold it in open position. 4 claims.

8077 Lift gas heat exchanger. Austin, D.L. (to Sun Oil Co.). US Patent 4,154,297. 15 May 1979. Filed date 8 Dec 1977. 6p.

The object of this invention is to provide an improved heat exchanger for effecting the transfer of heat from well fluids to an injection gas employed in producing artificial lift in a well. The heat exchanger should be relatively simple and inexpensive to produce and install into the injection system. The design of the heat exchanger is described. 3 claims.

8078 Surfactant oil recovery process usable in a formation having high salinity connate water. Carlin, J.T.; Wells, J.A.; Tyler, T.N. (to Texaco Inc.). US Patent 4,154,301. 15 May 1979. Filed date 29 Jun 1978. 8p.

This invention relates to a surfactant waterflood process for the recovery of oil from a subterranean oil-bearing formation containing a high salinity connate water. An aqueous surfactant slug containing a commercially available petroleum sulfonate is injected followed by the injection of an aqueous drive agent. Improved recovery is obtained if a co-surfactant and a mono-unsaturated secondary alcohol are added to the surfactant slug. 12 claims.

8079 Production of high viscosity glucans from hydrolyzed cellulosics. Compere, A.L.; Griffith, W.L. (Oak Ridge National Lab., TN). *Dev. Ind. Microbiol.;* **19**: 601-607(1978).

Several organisms tested, including Sclerotium glucanicum NRRL 3006 and Helotium sp. NRRL 3129, were able to make high viscosity glucan polymers from the hydrolysis products of naturally occurring lignocellulosic materials. Hydrolysis of the tested materials was accomplished by swelling in mild alkali for a 24-h period followed by hydrolysis in mild acid for a 30-min period at 121 C. The medium used for polymer production consisted of hydrolyzed lignocellulosic materials, salts, and a trace of yeast extract. Starch also was used as a fermentation feedstock, but was not hydrolyzed. The fermentations were performed over 4- or 5-day periods.

PROCESSING

REFER ALSO TO CITATION(S) 8096

8080 Method for producing a stabilized gasoline-alcohol fuel. Landis, P.S. (to Mobil Oil Corp.). US Patent 4,154,580. 15 May 1979. Filed date 9 Jan 1978. 12p.

Stable gasoline-alcohol fuel mixtures are produced by hydration of a gasoline or a fraction thereof high in olefins in the presence of an acid catalyst to form a high alcohol content gasoline mixture. The mixture is blended with a gasoline containing up to about 20 volume percent of methanol. The addition of the catalytically hydrated gasoline or olefinic fraction thereof serves to maintain the methanol in complete solution at low temperatures, particularly in the presence of water containment. 11 claims.

8081 Polymer combinations useful in distillate hydrocarbon oils to improve cold flow properties. Wisotsky, M.J. (to Exxon Research and Engineering Co.). US Patent 4,153,424. 8 May 1979. Filed date 22 Apr 1977. 12p.

Oil soluble ethylene polymers or copolymers having a M/sub n/ less than about 4000 in combination with an oil soluble polyester material such as a homopolymer or copolymer comprising, at least 10% by weight C_4 to C_{16} substantially straight-chain alkyl esters of acrylic or methacrylic acid, are useful in improving the cold flow properties of distillate hydrocarbon oils. 4 claims.

8082 Catalytic cracking with reduced emission of noxious gases. Vasalos, I.A.; Ford, W.D.; Hsieh, C.K.R. (to Standard Oil Co. (Indiana)). US Patent 4,153,535. 8 May 1979. Filed date 8 Dec 1976. 46p.

The invention is a cyclic, fluidized catalytic cracking process providing reduced emissions of carbon monoxide and sulfur oxides in the regeneration zone flue gases. Substantially complete combustion of carbon monoxide takes place in the regeneration zone, and the heat evolved is absorbed by solid particles which are circulated to the reaction zone and stripping zone before returning to the regeneration zone. Such solid particles comprise molecular sieve-type cracking catalyst (a catalyst matrix containing crystalline aluminosilicate distributed throughout) and a metal reactant and can also contain amorphous cracking catalyst, solids which are substantially inert to the cracking of hydrocarbons, and a metallic promoter. The metallic promoter can be confined within the regeneration zone. The metallic reactant reacts with a sulfur oxide to form a metal- and sulfur-containing compound in the solid particles. 35 claims.

8083 Cracking with catalyst modified by antimony thiophosphate. McKay, D.L. (to Phillips Petroleum Co.). US Patent 4,153,536. 8 May 1979. Filed date 1 Jun 1978. 12p.

The presence of varying amounts of metals such as nickel, vanadium, and iron, in hydrocarbon feedstocks can cause deterioration of the catalyst during the cracking process. In fact, some oils contain these metals in such high concentrations that that they cannot be cracked into gasoline and other fuels. Prevention of the detrimental effect of the presence of these metals can be achieved by using a cracking catalyst containing less than 40 wt % zeolite and including antimony oxide or a compound convertible to antimony oxide. Some additional expense is incurred with the installation of additional feeding means used to introduce the passivating agent into the cracking system. 13 claims.

8084 Apparatus for and method of reclaiming and cleaning oil from bottom settlings of tanks. Davis, L.R. US Patent 4,153,553. 8 May 1979. Filed date 29 Sep 1977. 8p.

The abstract describes a model unit which can be used for the treatment of bottom settlings (BS) to separate the saleable oil, water, residue, and to clean the oil storage tank. The treatment tank contains necessary pipes, valves, and pumps for withdrawing the BS from the bottom of the storage tank. A heating apparatus treats the BS until the water and oil are separated. The saleable oil is returned to the cleaned storage tank. The water and the residue are discharged at a suitable place. 5 claims.

8085 Cryothermal manipulation of petroleum. Ross, S.L.; Shuffman, O. US Patent 4,153,537. 8 May 1979. Filed date 23 Jun 1978. 10p.

A method is described for removing impurities from petroleum by placing a mixture of crude oil and water into a container. A cryothermal substance, such as liquid, in the temperature range of -321 to -345°F, can be introduced to freeze the water and to increase the surface tension of the petroleum. The method also allows heating of the petroleum and frozen water mixtures in the container prior to the removal of the treated oil. The invention has particular application with respect to the problem of recovering oil which has been inadvertently spilled on a body of water such as the ocean, for example when an oil well casing leaks or when the hull of an oil tanker is damaged and petroleum escapes. 4 claims.

8086 Prepurification of toluene dealkylation effluent gas. Saunders, J.B.; Davis, J.S. (to Union Carbide Corp.). US Patent 4,153,428. 8 May 1979. Filed date 30 Aug 1977. 24p.

A process is described for the separation of water and cyclic hydrocarbons from a gas mixture containing hydrogen, methane, water and cyclic hydrocarbons. An adsorption zone is designed to include two adsorbent beds connected in series, one bed containing a selective adsorbent for the hydrocarbons, the other bed containing a selective adsobent for water. Following the passage of the gas mixture through the beds, the adsorbents may be regenerated by purge gases. 19 claims.

PRODUCTS AND BY-PRODUCTS

8087 Fuel compositions containing deposit control additives. Lewis, R.A.; Honnen, L.R. (to Chevron Research Co.). US Patent 4,160,648. 10 Jul 1979. Filed date 27 May 1977. 15p.

Fuel compositions for internal combustion engines are provided which contain deposit control additives which maintain cleanliness of intake systems without contributing to combustion chamber deposits. The additives are polyloxyalkylene carbamates comprising a hydroxy- or hydrocarbyloxy-terminated polyloxyalkylene chain of 2 to 5 carbon oxyalkylene units bonded through an oxycarbonyl group to a nitrogen atom of a polyamine having from 2 to 10 amine nitrogens and from 2 to 40 carbons with a carbon:nitrogen ratio between about 1:1 and 10:1. 22 claims.

8088 Additives for lubricants and fuels. Kluger, E.W.; Miley, J.W.; Su, T.K. (to Milliken Research Corp.). US Patent 4,153,567. 8 May 1979. Filed date 10 Nov 1977. 10p.

Polyamino substituted cycloaliphatic compounds simultaneously treated with at least one olefin polymer substituted with succinic anhydride or at least one alkyl substituted succinic anhydride in which the alkyl moiety contains at least 8 carbon atoms produce oil dispersible compounds.

8089 ω-disubstituted amino alkanoic acid-n-amides as fuel additives. Graefje, H.; Nottes, G.; Mueller, H.; Daumiller, G.; Hoffmann, H. (to BASF Aktiengesellschaft). US Patent 4,153,425. 8 May 1979. Priority date 15 Jul 1975, German, Federal Republic of (F.R. Germany), 8p.

The compounds of the ω-N-disubstituted aminoalkanoic acid N' of the formula, may be added in small quantities to gasoline and effect the cleaning of the carburetor and obviate formation of deposit on the valves.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 8702

8090 (ANL/SPG—15) Effect of price controls on the production of crude petroleum. Krumm, R.J.; Townsend, S.B. (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 31p. Dep. NTIS, PC A03/MF A01.

The recent history of petroleum prices, production, and reserves is illustrated in a series of tables and federal price controls since 1972 are reviewed. Price controls are shown to reduce the level of output through a variety of mechanisms. They reduce the optimal level of all inputs since the marginal value product of each input is reduced when the price received for crude oil is reduced. They also cause current production to be shifted toward the future in an attempt to reduce current costs. Finally, price controls reduce the desired level of investment in new reserves by truncating the distribution of possible future prices, thereby reducing the expected price.

8091 (DOE/EIA—0201/1) Effects of oil regulation on prices and quantities: a qualitative analysis. Volume 1. Energy policy study. Dickens, P.F. III. (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1979. 104p. Dep. NTIS, PC A06/MF A01.

This paper is the first in a series that will assess the economic impacts of the entire set of governmental actions that differentially affect energy markets. Examined here are the effects of federal oil regulations on the markets for crude oil and its refined products. The directions in which prices and quantities are altered by these regulations are determined by a qualitative economic analysis. Comparisons are made between the price and output decisions of the markets as presently operating and those decisions in the absence of these regulations. The latter situation is thought to approximate free, competitive markets.

8092 (EMD—80-24) Analysis of current trends in US petroleum and natural gas production. Staats, E.B. (General Accounting Office, Washington, DC (USA)). 7 Dec 1979. 70p. General Accounting Office, Washington, DC.

Report to the Congress of the United States by the Comptroller General.

The purpose of this report is to identify the key indicators affecting future oil and gas supplies and analyze the current trends of these indicators. The key indicators used in this analysis are: (1) the size and location of the domestic petroleum and natural gas resource base, (2) the trends in reserve additions by category (revisions,

extensions, new finds in existing or new fields), (3) the trends in US reserve additions by year of discovery for each field, (4) levels of drilling activity, including reserves discovered per foot drilled, reserves discovered per well, and average new field size, (5) production trends for large oil fields, and (6) experience in frontier exploration. This assessment seeks to weigh these indicators against relevant US petroleum and natural gas data and establish correlations and other relationships that will define the important trends affecting future supply. Information was obtained from Government, industry, and academic sources. Published data and information obtained through interviews with selected energy forecasters in these organizations are used as a basis for this report. The report includes the following: an assessment of the resource implications for future US petroleum and conventional natural gas production, the US petroleum supply outlook to the year 2000, the US natural gas supply outlook to the year 2000, a comparison of our results with those of other recently published forecasts representing a reasonable cross-section of institutional views, and implications and conclusions drawn from the findings of this analysis. The future domestic supply estimates presented herein are not considered definitive forecasts, and do not include supplies from non-conventional crude oil (e.g., oil shale and tar sands) and natural gas (e.g., tight formations, coal seams, Devonian shale, geopressurized reservoirs). Price effects are not explicitly taken into account in this work.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 8082, 8084, 9162, 9207

8093 (BETC/RI—79/14) **Pilot-scale used oil re-refining using a solvent treatment/distillation process.** Cotton, F.O.; Brinkman, D.W.; Reynolds, J.W.; Goetzinger, J.W.; Whisman, M.L. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Jan 1980. 46p. Dep. NTIS, PC A03/MF A01.

Approximately 1000 gallons of used automotive lubricating oil were collected from service stations in the Bartlesville region. This oil was then processed using the patented technology developed by the Bartlesville Energy Technology Center (BETC) in earlier work. The resulting lube oil basestock was tested by both physical and chemical analytical techniques and rigorous engine sequence tests. The end product was a high-quality lubricating oil which passed all requirements for SE service. Analyses of the oil are presented at the end of each stage of processing to demonstrate the effects of that phase. 7 figures, 18 tables.

8094 (NTIS/PS—79/0876) **Waste processing and pollution in the chemical and petrochemical industries. Volume 3. 1977 (a bibliography with abstracts). Report for 1977.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Sep 1979. 176p. NTIS PC N01/MF N01.

This bibliography cites reports concerning waste processing and pollution in the chemical and petrochemical industries. Topics discussed include emissions, economics, control processes, pollution effects, and abatement strategies. (This updated bibliography contains 170 abstracts, none of which are new entries to the previous edition.)

8095 (NTIS/PS—79/0877) **Waste processing and pollution in the chemical and petrochemical industries. Volume 4. 1978-August, 1979 (a bibliography with abstracts). Report for 1978-August 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Sep 1978. 197p. NTIS PC N01/MF N01.

These citations from Federally funded research cover many aspects of waste processing and pollution in the chemical and petrochemical industries. The bibliography includes emissions, economics, control processes, pollution effects, and abatement strategies. (This updated bibliography contains 170 abstracts, 126 of which are new entries to the previous edition.)

8096 **Catalytic cracking with reduced emission of noxious gases.** Vasalos, I.A. (to Standard Oil Co. (Indiana)). US Patent 4,153,534. 8 May 1979. Filed date 8 Dec 1978. 36p.

The invention is a cyclic, fluidized catalytic cracking process providing reduced emissions of sulfur oxides in the regeneration zone flue gases. The system is operated with homogeneous or nonhomogeneous, regenerable, fluidized, solid particles which are circulated throughout the catalytic cracking process cycle. The system consists of (1) a molecular sieve-type cracking catalyst matrix containing crystalline aluminosilicate distributed throughout and (2) ideally a metallic reactant which sould be at least one free or combined element selected from the group of sodium, manganes, or copper. Rare earths or other transition metals and their oxides may also be used. 30 claims.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 8046, 8085, 8094, 8095, 9219

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 8091, 8670, 8671, 8672, 8673, 8674, 8675, 8676, 8677, 8683, 8698

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 8781

8097 **Method for transportation of viscous hydrocarbons by pipeline.** Kalfoglou, G.; Flournoy, K.H. (to Texaco Inc.). US Patent 4,153,575. 8 May 1979. Filed date 11 Jan 1978. 6p.

A method of transporting viscous hydrocarbons is described, which involves introducing into a pipeline or well-bore with the viscous hydrocarbons a solution containing an oxyalkylated anionic surfactant such as sodium nonyl phenol polyoxyethylene sulfonate or a mixture of such surfactants and, optionally, with an alkalinity agent thereby forming a low-viscosity, salt-tolerant oil-in-water emulsion.

PROPERTIES

REFER ALSO TO CITATION(S) 8905

8098 **Detecting trace lead in gasolines.** Olson, D.C. (to Shell Oil Co.). US Patent 4,153,517. 8 May 1979. Filed date 22 May 1978. 6p.

The patent described an improved galvanic detector to be used for measuring trace amounts of tetralkyl lead in gasoline. A disk of dried porous material is placed in a holder mounted on a turntable. A small sample of gasoline is placed on the porous material and is allowed for a pre-set time in order to remove the olefins. The turntable is then rotated to pass the disk over a sensory electrode of the galvanic cell. The peak value of the current signal produced is measured and recorded. 2 claims.

COMBUSTION

REFER ALSO TO CITATION(S) 8956

NATURAL GAS

REFER ALSO TO CITATION(S) 8000, 8063, 8663

8099 **Prioritization methodology for the allocation of public sector R and D investment among unconventional gas resources.** Holman, W.R. Jr. (Booz-Allen and Hamilton Inc, Bethesda, Md). pp 48-56 of Second Lawrence symposium on systems and decision sciences. North Hollywood, CA; West Period Co. (1978).

From 2. symposium on systems and decision sciences; Berkeley, CA, USA (2 Oct 1978).

The paper describes the formulation and application of a resource-allocation methodology employed in the development of a Federal research and development strategic plan for exploitation of the nation's vast unconventional gas resources. The methodology was developed in support of a forty-member task force comprised of professionals from the Department of Energy, Bureau of Mines, United States Geological Survey, and private-contractor organizations. The task force's principal mission was the formulation of a five-year Department of Energy R and D program in technology development to unlock the potential of the unconventional gas resources.

8100 (LIB-tr—4511) **Natural gas in Sweden - a current survey.** Wahlman, E.; Teryd, R. Translated from *VVS - Tidskr. Vaerme-, Vent.-, Sanit.- Kyltetek.;* No. 5, 101-105(1978). 18p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Natural gas comprises an interesting alternative within the Swedish energy policy. Discussions are underway which could lead to a natural gas distribution network being installed in southwestern Sweden. The technical and economic importance of natural gas to Sweden is presented.

RESERVES

8101 (GRI—79/0009) **Proceedings of the GRI gas hydrate workshop.** (Gas Research Inst., Chicago, IL (USA)). 1 Feb 1979. 59p. NTIS, PC A04/MF A01.

A one-day workshop on natural gas hydrates was held in Denver on February 1, 1979, to identify current knowledge on the subject and to determine the most likely avenues of research and development that could be followed. The following general conclusions were drawn from the workshop discussions. The behavior of the pure components of hydrate-containing systems has been well-studied. In naturally occurring deposits, however, additional components and phases may be present. Relatively little is known about the characteristics of naturally occurring gas hydrates or their effects within the sediments in which they exist - primarily the permafrost region and marine sediments. Either core samples have not been taken or the test results have not been publicly released. The limited information available from the USSR concerning hydrate resources is not considered to be fully reliable. Nevertheless, the estimated resources are very large, possibly 10^{13} m^3 or more. Exploratory well drilling activities in northern Alaska, the Mackenzie Delta, Beaufort Sea, and the Arctic Islands area are encountering hydrates; and hydrates may be widespread in the northern portion of the northern hemisphere. Although no resource estimates are even somewhat reliable, there appears to be a vast amount of gas in the hydrate state. The technical and economic feasibility of proposed recovery methods is not known, and their comparative intricacies have not been spelled out. No detailed process design, net energy analysis, or economic study has been made. All estimates so far are extremely rudimentary.

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 9393

8102 (FE—2287-T9) **Shale characterization and resource appraisal of Devonian black shale in the Appalachian basin. Annual report, October 1, 1977-September 30, 1978.** (Geological Survey, Reston, VA (USA)). 1978. Contract EX-76-A-01-2287. 25p. Dep. NTIS, PC A02/MF A01.

The USGS Devonian Shale Characterization and Resource Appraisal Program was subdivided into 8 active and one dormant project in FY/1978: stratigraphic studies, structural studies, geophysics-borehole gravity, geochemistry, condonont maturation and paleontology, trace element studies, clay mineralogy, data storage, and resource appraisal.

8103 (ORO—5205-T5) **Characterization and analysis of Devonian shales as related to release of gaseous hydrocarbons. Well N-1 Henderson County, Illinois and Well N-2 Tazewell County, Illinois.** Kalyoncu, R.S.; Boyer, J.P.; Snyder, M.J. (Battelle Columbus Labs., OH (USA)). 15 Jun 1979. Contract EY-76-C-05-5205. 185p. Dep. NTIS, PC A09/MF A01.

Core sampling, hydrocarbon gas contents, chemical and physical characterization data are presented. Core samples from these two Illinois basin wells were obtained in July and August 1977. Thirty-one and twenty-three samples were obtained from N-1 and N-2 wells, respectively, amounting to total core length of 940 feet. Shales from Illinois basin wells (such as N-1 and N-2) are characterized by very low hydrocarbon gas contents. In fact, the N-1 and N-2 wells exhibited the lowest hydrocarbon gas contents among all the wells thus far analyzed. The chemical analysis of these shales also indicates rather low carbon and hydrogen contents, supporting the hydrocarbon gas release data. One significant aspect of the physical characterization data is high porosity associated with low bulk densities. N-1 and N-2 shales exhibit the highest pore volume of any shales from either basin (Appliachian and Illinois). Lithology of these shales does not significantly differ from those of other locations. These shales exhibit relatively low carbonates.

8104 (LIB-tr—4603) **Natural gas resources in geopression zones.** Grenon, M. Translated from *Rev. Energ.:* **29**: No. 304, 280-285(May 1978). 11p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The best known accumulations of gas in geopression zones are in the Gulf of Mexico. The general characteristics of these zones and the dissolved gases are described. The two best sites are the sand of Fri-Vicksburg in Texas and the Miocene in Louisiana. The production modules for gas recovery and energy recovery are discussed. Two tests were made on abandoned or active wells. Distribution of geopression zones over the world is discussed. (DLC)

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 8973

8105 (DOE/BG/01569—16) **Western Gas Sands Project. Quarterly basin activities report, July 1-September 30, 1979.** (CER Corp., Las Vegas, NV (USA)). 1979. Contract AC08-79BG01569. 41p. Dep. NTIS, PC A03/MF A01.

This report is a summation of three months drilling and testing activities in the four primary study areas of the WGSP: Northern Great Plains Province, Greater Green River Basin, Piceance Basin, and Uinta Basin.

8106 **Method for reducing contaminant emissions in gas drilling operations.** Pye, D.S. (to Union Oil Company of California). US Patent 4,161,222. 17 Jul 1979. Filed date 1 Jun 1978. 14p.

An improved gas drilling method for drilling a well through steam-bearing formations in which emissions of particulate material and other contaminants are reduced by imposing a surface back pressure on, and thereby reducing the velocity of, the contaminant-bearing gas rising through the well. The drilling cuttings and other particulate material rising through the well are subjected to less abrasion and therefore arrive at the surface as larger, more easily separated particles. Drill string erosion is also reduced by the method and the efficiencies of any well effluent treatment facilities are increased. 17 claims.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 8856

8107 (GRI—78/0017) **Utilization of cold in LNG baseload and peakshaving plants.** Hipkin, H.G.; Stenzel, R.A. (Gas Research Inst., Chicago, IL (USA)). 15 Oct 1979. 151p. NTIS, PC A08/MF A01.

This report presents the results of a survey of the uses of the refrigeration available from vaporizing liquefied natural gas. The major emphasis of the study is on peakshaving plants, which liquefy and regasify domestic gas; the minor emphasis is on base-load terminals, which gasify imported LNG continuously. There are 54 full-scale LNG peakshaving plants in the US and several others under construction. The US has three operating base-load import terminals. One more is under construction and several more large terminals have been proposed. There are at least 12 foreign base-load import terminals in operation, and more are under construction or are proposed. The report presents a survey of operating conditions for about 15 large domestic peakshaving plants. It also presents published design data for the existing US import terminals, for the major proposed import terminals, and for the major overseas import terminals. The second section of the report presents the technology of cold utilization, discusses the literature that has been published in the area together with economics that have been published, and looks at the application of the technology to peakshaving plants.

8108 (LIB-tr—4523) **Cedigaz: LPG.** (British Gas Corp., London). Feb 1978. Translation source information not available. 51p. Dep. NTIS (US Sales Only), PC A04/MF A01.

Portions of document are illegible.

This document is divided into two parts. Part I defines the products, their origins, and uses. Part II gives the world prospects for the development of the products according to their origins and looks at the present position of LPGs in the areas of production and consumption and the development of this situation up to 1985. (DLC)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 8092, 8702

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 8046, 8109

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 8072

8109 (DOE/EDP—0049) **Unconventional gas recovery (enhanced gas recovery).** (Department of Energy, Washington, DC (USA)). Oct 1979. 71p. Dep. NTIS, PC A04/MF A01.

The main objective of the Unconventional Gas Recovery (UGR) program is to increase the recoverable natural gas reserves of the United States by developing and demonstrating new gas recovery methods tthat will make it economically possible to produce gas resources that are currently uneconomic. There are four resource targets for future development within the UGR program: the gas-bearing Devonian shales of the Eastern United States; the low-permeability (tight) gas sandstones of the Rocky Mountain region; the free methane present within coal seams; and the high-pressure, methane-saturated saltwater aquifers of the Gulf Coast region. New processes currently being developed and tested to assist conventional gas extraction processes in the recovery of unconventional gas resources are advanced hydraulic fracturing, chemical explosive fracturing, and directionally deviated wells. The highest priority environmental concerns associated with UGR are: preparation of Environmental Impact Statements for siting and construction of new support pipelines to gather and transport gas produced from UGR operations, and possible contamination of air and water. Chapters are devoted to the technology program, commercialization plan for unconventional gas recovery, environmental concerns and requirements, and environmental strategy.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 8670, 8671, 8672, 8673, 8674, 8675, 8676, 8677, 8685

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 8218, 8781

8110 (IVL-B—485) **Propulsion of tankers by combustion of gas from the cargo.** Svedung, I. (Institutet foer Vatten- och Luftvaardsforskning, Fryksta (Sweden)). Jan 1979. 21p. (STU—77-4417). Dep. NTIS (US Sales Only), PC A02/MF A01.

The technical and economic possibilities of using the property of the crude oil to solute gas in order to have gas as cargo in conventional tankers have been investigated. During the transport an off-gas system will make the gas available for propulsion of the tanker. The procedure is considered technically feasible and safe and would give lower costs for propulsion of tankers.

8111 **Selection of natural gas compressor stations for potential demonstration sites for gas turbine bottoming cycles.** Rossbach, R.J.; Alpaugh, R.T. (GE, Adv Enrgy Programs). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1029-1034(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The Department of Energy has formulated a Pipeline Bottoming Cycle Program with the objectives of carrying out the necessary research, development and demonstration of bottoming cycle apparatus so that through the application of this apparatus to the gas-fueled prime movers used to pump natural gas the amount of fuel used can be substantially reduced. In this paper the selection of three simple-cycle gas turbine-driven compressor stations is shown to provide sites in which bottoming cycle apparatus has broad applicability to new and retrofit applications, sites which have good potential for near-term implementation and thus represent favorable cost/benefit ratios, and sites in which the bottoming cycle has the potential of reducing the heat rate of the prime mover to which the bottoming cycle is applied more than 20%.

STORAGE

REFER ALSO TO CITATION(S) 8070

OIL SHALES AND TAR SANDS

RESERVES AND EXPLORATION

8112 **Colorado's oil-shale resource for vertical modified in-situ processes.** Smith, J.W.; Beard, T.N.; Trudell, L.G. (US Dep of Energy, Laramie Energy Res Cent, Wyo). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 329-335(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Vertical modified in-situ processes for oil-shale development require an accessible, thick and continuous oil-shale section. In colorado's Piceance Creek Basin the Mahogany zone and its overlying oil-shale is the Green River Formation section that best meets these requirements. This oil-shale section is described and evaluated with contour maps of richness, thickness, and oil resource in place. Total oil in place basin-wide in this primary resource is 419 billion barrels with 85 percent occuring in areas with resource exceeding 400,000 bbls per acre. Ninety-five percent of the resource occurs in sections thicker than 300 feet.

SITE GEOLOGY

REFER ALSO TO CITATION(S) 8064, 8102, 8103

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 8127

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 8068, 9393

8113 (DOE/LC/10036—T1) **Occidental vertical modified in situ process for the recovery of oil from oil shale, Phase II. Quarterly progress report, June 1, 1979-August 31, 1979.** McDermott, W.F. (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Oct 1979. Contract FC20-78LC10036. 81p. Dep. NTIS, PC A05/MF A01.

Objectives are to: construct, tracer/flow test, and simultaneously process two side-by-side large scale retorts (Retorts 7 and 8) formed by blasting to a horizontal free face; conduct small-scale start up tests, prior to ignition of Retorts 7 and 8, on at least two quarter size retorts (miniretorts); develop mine stability data for commercial size retorts; develop and test advanced retort ignition systems; collect evaluate and report environmental data; and test special mining and remote sensing equipment. This quarterly report covers the activities for the first three months of the Phase II Program. The major activities at Logan Wash and on Phase II during the months of June, July, and August were: driving the access and ventilation drifts towards the underground locations for Retorts 7 and 8; beginning construction for surface facilities; mining the rooms for the mini retorts; and developing an instrumentation program for DOE funding.

8114 (FE—2346-49) **Energy from in situ processing of Antrim oil shale. Quarterly technical progress report, April-June 1979.** Washington, L.J. Jr. (Dow Chemical Co., Midland, MI (USA). Process Development Dept.). 20 Jul 1979. Contract EX-76-C-01-2346. 43p. Dep. NTIS, PC A03/MF A01.

Four wells were drilled and cored in the 100 series for use in evaluating the fracturing which had been accomplished in Wells No. 101-106 and for possible use in subsequent extraction trials. Extensive logging, liquid permeability, air permeability and well communication tests were carried out for fracture assessment at both the hydraulic/explosive fracture site and the explosive underream site. Although these evaluations are still incomplete, and no decision can yet be made as to which site would be preferred for an extraction trial, both sites have much greater permeability and better interwell communications than was present in the first extraction trials on the existing Dow site. Preparations for the planned extraction trial are continuing; it is expected that all systems will be complete and in readiness for an extraction trial to begin in August.

8115 (LETC—10787-25) **Geokinetics In Situ Shale Oil Recovery Project. Second annual report, March, 1979.** Lekas, M.A. (Geokinetics, Inc., Concord, CA (USA)). Mar 1979. Contract ET-78-F-03-1787. 61p. Dep. NTIS, PC A04/MF A01.

The project is being conducted at a field site located 70 miles south of Vernal, Utah. Because of the remote location of the site, and its poor accessibility over unpaved roads, a fully self-contained field camp was constructed to support the project and provide living quarters for the field crew. Eighteen in-situ retorts have been constructed, ranging in size from 330 tons to 46,000 tons. Eleven of these retorts have been burned, and a total of 5400 barrels of shale oil have been recovered. Oil shale thicknesses of 30 feet, and cross-sectional areas of 3800 square feet have been successfully blasted. The results have been encouraging, and the project will continue to scale up its size of the operation in 1979.

8116 (SAN—1747-T1) **BX In Situ Oil Shale Project. Annual technical progress report, March 1, 1978-February 28, 1979 and quarterly technical progress report, December 1, 1978-February 28, 1979.** Jacobs, H.R. (Equity Oil Co., Salt Lake City, UT (USA)). 20 Mar 1979. Contract ET-78-F-03-1747. 171p. Dep. NTIS, PC A08/MF A01.

February 28, 1979 marks the end of the second year of work on the BX In Situ Oil Shale Project. Work accomplished during the year included the drilling and testing of all project injection and production wells; the installation and construction of project surface

facilities; the installation and construction of laboratory research equipment; and the implementation of an environmental monitoring plan at the Project site.

8117 (SAN—1848-T1) **Occidental vertical modified in situ process for the recovery of oil from oil shale: Phase I. Quarterly progress report, November 1, 1978-January 31, 1979.** (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Feb 1979. Contract ET-78-C-03-1848. 783p. Dep. NTIS, PC A99/MF A01.

The Retort 6 operating conditions were steady for most of the quarter and oil production increased to an average three hundred barrels per day. Severe weather conditions caused numerous problems with steam and air injection to the retort. The construction activities centered on completion of the oil/water separation tank and installation of the off-gas condenser pilot plant. The oil and gas analyses for the retort operation since start-up are included. The process water analyses are part of the hydrology section of Appendix B, Environmental Data Analyses. At the C-b Tract, the shaft sinking operation was begun at the Ventilation/Escape Shaft on January 15, 1979. The construction activities continued in preparation for shaft sinking at the Production and Service Shafts. Appendices include: thermocouple data, environmental data analyses, development guide for Rifle, Colorado, and shale oil analyses report.

8118 (SAN—1848-T2(Vol.1)) **Occidental vertical modified in situ process for the recovery of oil from oil shale: Phase I. Annual report, November 1, 1977-October 31, 1978.** (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Mar 1979. Contract ET-78-C-03-1848. 454p. Dep. NTIS, PC A20/MF A01.

Progress of the Phase I work performed is reported. This phase of the project is the engineering development of the OXY modified in situ process for recovery of shale oil being performed at the D.A. Shale site northeast of DeBeque, Colorado. This phase covers the processing of Retort 5, the formation and processing of Retort 6, and the preparation of a definitive engineering design and cost estimate for the technical feasibility demonstration plant. The primary objective of Phase I is to evaluate two alternative retort designs considered for commercial application. The first, Retort 5, used a single vertical slot to provide the void volume and free face necessary for rubblization; and the second, Retort 6, used a series of horizontal rooms, separated by solid sections of oil shale. The purpose of the evaluation is to select the retort design to be used in the Phase II technical feasibility demonstration. More specifically, the purpose is to compare such factors as gas flow patterns, void and particle size distribution, and pressure drop across the retort in a rubble pile formed by blasting into horizontal rooms as opposed to blasting into vertical slots. In addition, the effect of air/steam mixtures on oil yield, process water requirements, and off-gas composition and heating value is being studied. Topics covered include the completion of Retort 5 processing; Retort 6 rubblization, construction, testing, ignition, and retorting; the environmental support at Logan Wash; the design progress for the Phase II demonstration facility; C-b commercial facility activities and environmental support; the status of marketing studies; and the schedule status and plans for the coming year. Appendices included are: measurements of blasting for Retort 6, instrumentation of Retort No. 6, and flow/tracer test data of Retort No. 6.

8119 (SAN—1848-T2(Vol.2)) **Occidental vertical modified in situ process for the recovery of oil from oil shale: Phase I. Annual report, November 1, 1977-October 31, 1978.** (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Mar 1979. Contract ET-78-C-03-1848. 497p. Dep. NTIS, PC A21/MF A01.

Progress on the engineering development of the OXY modified in-situ process for recovery of shale oil is reported. The appendices included in this volume are: spill prevention, control and countermeasure plan; vegetation data and analysis for July 1978; dust and noise data, Logan Wash reclamation plan, Retort 6 permits, special use of permit application, C-b tract permits and reclamation plan, and C-b shale oil venture socio-economic monitoring report No. 2.

8120 (SAN—1848-T2(Vol.3)) **Occidental vertical modified in situ process for the recovery of oil from oil shale: Phase I. Annual report, November 1, 1977-October 31, 1978.** (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Mar 1979. Contract ET-78-C-03-1848. 526p. Dep. NTIS, PC A23/MF A01.

Progress on the engineering development of the OXY modified in-situ process for recovery of shale oil is reported. The appendices included in this volume are: development guide for Meeker, Colorado; alternatives and guidelines for C-b shale oil venture training program; refining oil shale; and petroleum products supply-demand projections for the area served by Rocky Mountain refineries.

SURFACE METHODS

REFER ALSO TO CITATION(S) 8073

8121 **Processing of tar sands.** Audeh, C.A.; Chen, N.Y. (to Mobil Oil Corp.). US Patent 4,161,442. 17 Jul 1979. Filed date 5 Jan 1978. 6p.

Petroliferous material of tar sands is processed to recover material boiling below 850°F with higher boiling material converted to high Btu fuel gas and with heat developed transported to improve the thermal efficiency of the combination operation. 12 claims.

8122 **Iron-containing refractory balls for retorting oil shale.** Pollock, L.W. (to Phillips Petroleum Co.). US Patent 4,160,719. 10 Jul 1979. Filed date 28 Sep 1977. 8p.

Iron-containing refractory balls, in a retorting process for oil shale, permit effective magnetic separation of the balls from the spent shale. 10 claims.

8123 **Shale conversion process.** Kirkbride, C.G. US Patent 4,153,533. 8 May 1979. Filed date 7 Sep 1977. 8p.

The patent describes a process for converting the kerogen of oil shale to oil products. Shale particles are dried, mixed with hydrogen at an elevated pressure, and the mixture is subjected to wave energy in the microwave range. Under the influence of the microwaves, the kerogen is split from inorganic matter and the sulfur present is converted to hydrogen sulfide so that substantially sulfur-free, relatively saturated oleaginous products are obtained.

REFINING

8124 **Upgrading shale oil.** Gorring, R.L.; Smith, R.L. (to Mobil Oil Corp.). US Patent 4,153,540. 8 May 1979. Filed date 4 May 1977. 8p.

Liquid products from retorting oil shale are upgraded to a total liquid suited to pipeline transport and containing increased amounts of the premium products of gasoline through distillate fuel. The result is accomplished by an initial hydrotreating of the shale oil to convert sulfur, nitrogen, and oxygen derivatives of hydrocarbons to hydrogen sulfide, ammonia, and water, while depositing metal from hydrodecomposition of organometallic compounds. The effluent from the hydrotreater, is passed to a high severity hydrocracking zone over catayst containing a zeolite and a metal catalyst which initiate hydrogenation/dehydrogenation reactions. Hydrocracking conditions of temperature, pressure, and hydrogen concentration are adjusted to result in conversion of 50 to 70% of the material in the charge boiling above to products boiling below that temperature. 8 claims.

8125 **Prerefining true in situ shale oil.** Cottingham, P.L. (US Dep of Energy, Laramie, Wyo). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 318-321(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Crude shale oil from true in situ retorting of shale near Rock Springs, Wyo was hydro-treated at 1,500 psig pressure and 800°F to produce a liquid product from which 98 percent of the sulfur and nitrogen had been removed. The product was distilled to yield 36.7 volume percent of the feed as gasoline containing 24 parts per million nitrogen and 51.0 percent Nos. 1 through 4 diesel fuels with 160-400 ppm nitrogen. All diesel fuels qualified as low-sulfur, high-cetane diesel fuels. Hydrotreating the crude at 2,200 psig produced a total liquid product with only 53 ppm nitrogen and less than 100 ppm sulfur after 888 hours operation. This experiment continued through 1668 hours onstream; the final products are being analyzed.

PROPERTIES AND COMPOSITION

8126 **Comparison of shale oils from different sources produced by controlled-state retort.** Duvall, J.J.; Bartke, T.C. (US Dep of Energy, Laramie Energy Res Cent, Wyo). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 336-341(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Six oil shales from five different sources (including Colorado, Utah, Michigan, and Morocco) and of varying richness have been retorted in the controlled-state retort using the same retorting conditions. The oils produced have been analyzed for boiling-point composition, elemental content, and physical properties. The gases produced have been analyzed for composition. The results of the analyses show differences in oil and gas composition related to shale richness and shale source. These differences include the relationship of boiling-point composition to shale grade and shale source, physical properties to shale grade and shale source, product gas composition to shale grade and shale source, and elemental analysis of the oil to the shale source.

DIRECT USES AND BY-PRODUCTS

8127 **Jet fuels from shale oil: a near term technology.** Harney, B.M.; Ramsey, J.; Hildebrand, R. (US Dep of Energy). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 322-328(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The production of shale oil by surface and in situ technology is reviewed. Past and current programs on refining shale oil to get transportation fuels is discussed with emphasis on jet fuel production.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 8117, 8119, 8120, 9062, 9114, 9218, 9264

NUCLEAR FUELS

RESERVES

3128 **National Uranium Resource Evaluation program: what is it worth.** Gilbert, R.J.; Richels, R.G. (Univ of Calif, Berkeley). pp 31-39 of Second Lawrence symposium on systems and decision sciences. North Hollywood, CA; West Period Co. (1978).

From 2. symposium on systems and decision sciences; Berkeley, CA, USA (2 Oct 1978).

The National Uranium Resource Evaluation program was organized by the Department of Energy with the major goal of establishing reliable and timely estimates of domestic uranium resources. This paper presents a methodology for estimating the expected economic value of uranium-resource information. The information is modeled by a likelihood function and imbedded in the decision tree, which describes possible nuclear power development strategies. Preliminary results show that the uranium resource information must be very accurate to be of significant economic value.

EXPLORATION

8129 (GJBX—5(80)) **Hydrogeochemical and stream sediment reconnaissance of the National Uranium Resource Evaluation Program. Semiannual progress report, April-September 1979.** Morris, W.A.; Bunker, M.E.; Waterbury, G.R.; Waller, R.A. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 20p. (LA—8092-PR). Dep. NTIS, PC A02/MF A01.

During this six-month period, reconnaissance sampling was done in five partially completed quadrangles, the North Slope of Alaska, and the Panhandle of Alaska. Detailed geochemical survey sampling was done in nine follow-up study areas. About 23,000 waters and 25,000 sediments were collected, bringing the LASL totals to 165,000 waters and 185,000 sediments from 220,000 locations. Almost all of the Rocky Mountain region and 85% of Alaska have been sampled. About 9000 water and 22,000 sediment samples were analyzed for the standard LASL multielement suite (uranium plus 43 additional elements). Work continued on improving and automating all analytical techniques and building a state-of-the-art emission spectrograph for waters and sediments. The second neutron activation line became operational in July, bringing the sediment throughput to the designed 400 samples per day. Seven multielement reconnaissance reports, one detailed geochemical survey report, one semiannual progress report, and one topical report were open filed.

8130 (LA—8065-PR) **NDA technology for uranium resource evaluation. Progress report, July 1-December 31, 1978.** Evans, M.L. (comp.). (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 19p. Dep. NTIS, PC A02/MF A01.

The calculational work has focused on gamma-ray calculations, code improvements, and cross-section conversions. The experimental effort has concentrated on the design of a field prototype photoneutron logging probe and on uranium-fission neutron pulse-shape discrimination. The GAMRES code has been modified to provide the facility for computing gamma-ray response functions for different types of detectors. Calculations to identify the physical processes of importance in the operation of the disequilibrium probe have been completed. A field prototype photoneutron-based logging probe and associated radiation shielding cask are currently being designed. Feasibility studies have been initiated to investigate the use of (α,n) source for direct uranium ore-grade determination. Pulse-shape-discrimination (PSD) techniques are being investigated for use with photoneutron probes having liquid scintillation fast-neutron detectors.

8131 (LA—8092-PR) **Hydrochemical and stream sediment reconnaissance of the National Uranium Resource Evaluation Program, primarily for the Rocky Mountain States of New Mexico, Colorado, Wyoming, Montana, and the State of Alaska. Semiannual progress report, April-September 1979.** Morris, W.A.; Bunker, M.E.; Waterbury, G.R.; Waller, R.A. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 21p. Dep. NTIS, PC A02/MF A01.

Reconnaissance sampling was done in five partially completed quadrangles, the North Slope of Alaska, and the Panhandle of Alaska. Detailed geochemical survey sampling was done in nine follow-up study areas. About 23,000 waters and 25,000 sediments were collected, bringing the LASL totals to 165,000 waters and 185,000 sediments from 220,000 locations. Almost all of the Rocky Mountain region and 85% of Alaska have been sampled. About 9000 water and 22,000 sediment samples were analyzed for the standard LASL multielement suite (uranium plus 43 additional elements). Work continued on improving and automating all analytical techniques and building a state-of-the-art emission spectrograph for waters and sediments. The second neutron activation line became operational in July, bringing the sediment throughout to the designed 400 samples per day. Seven multielement reconnaissance reports, one detailed geochemical survey report, one semiannual progress report, and one topical report were open filed at the US DOE Grand Junction Office, Colorado.

8132 (LA-UR—79-3376) **Sample collection: an overview of the Hydrogeochemical and Stream Sediment Reconnaissance Program.** Bolivar, S.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 42p. (CONF-791156—1). Dep. NTIS, PC A03/MF A01.

From Geological Society of America annual meeting; San Diego, CA, USA (5 Nov 1979).

A Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) for uranium is currently being conducted throughout the conterminous United States and Alaska. The HSSR is part of the National Uranium Resource Evaluation sponsored by the US Department of Energy. This ambitious geochemical reconnaissance program is conducted by four national laboratories: Los Alamos Scientific Laboratory, Lawrence Livermore Laboratory, Oak Ridge Gaseous Diffusion Plant, and Savannah River Laboratory. The program is based on an extensive review of world literature, reconnaissance work done in other countries, and pilot studies conducted by each laboratory. Sample-collection methods and sample density are determined to optimize the probability of detecting potential uranium mineralization. To achieve this aim, each laboratory has developed independent standardized field collection procedures that are designed for its section of the country. Field parameters such as pH, conductivity, climate, geography, and geology are recorded at each site. Most samples are collected at densities of one sample site per 10 to 23 km^2. The HSSR program has helped to improve existing hydrogeochemical reconnaissance exploration techniques. In addition to providing industry with data that may help to identify potential uranium districts and to extend known uranium provinces, the HSSR also provides multi-element analytical data, which can be used in water quality, soil, sediment, environmental, and base-metal exploration studies.

FEED PROCESSING

8133 (BM-RI—8370) **Elution of uranyl carbonate from a strong base resin with a mixed carbonate eluant in a fluidized system.** Palmer, G.R.; Nichols, I.L.; Seidel, D.C. (Bureau of Mines, Salt Lake City, UT (USA). Salt Lake City Metallurgy Research Center). 1979. 25p. Bureau of Mines, Washington, DC.

The system consisted of a multiple-compartment ion-exchange (MCIX) elution column with a continuous flow of solution, except for short periods when the resin increments were withdrawn. The exchange of uranyl carbonate from the mill loaded strong base resin with an eluant composed of 1.0 M Na_2CO_3 plus 1.0 M NH_4HCO_3 was studied. The effects of solution flow rate, aqueous-to-resin flow ratio, column diameter, compartment height, initial resin concentration, and column length were examined. The experimental data indicate that for the eluant examined a resin residence time of 240 minutes is necessary to attain 90-percent elution efficiency. Also provided is a technique for sizing an elution MCIX column form pilot plant experimental data. 18 figures, 2 tables.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 8481, 8968, 8989

8134 (HEDL-SA—1723-FP) **Automated in-line measurement of nuclear fuel pellets.** McLemore, D.R.; Nyman, D.H. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 23p. (CONF-790602—91). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

HEDL is currently developing, fabricating, and evaluating automated fuel fabrication equipment with the goals of reduced personnel exposure, improved safeguards/accountability and improved fuel performance. One of the automated equipment items which has been fabricated is a fuel pellet inspection system. This system inspects fuel pellets for surface flaws and measures pellets for length, diameter, and weight at a rate of one pellet per second. The inspected pellets are sorted automatically and the results of the inspection are transmitted to a central computer for trend analysis and verification of accountability data. 11 figures.

8135 (HEDL-SA—1830) **Equilibrium oxygen potential-composition relations in hypostoichiometric plutonia.** Woodley, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 16 Jul 1979. Contract EY-76-C-14-2170. 14p. (CONF-791045—5). Dep. NTIS, PC A02/MF A01.

From American Ceramic Society conference; New Orleans, LA, USA (14 Oct 1979).

The oxygen potential of hypostoichiometric plutonia at temperatures from 1000 to 1200°C has been measured as a function of the oxygen-to-plutonium ratio by a thermogravimetric procedure. These data have been used to calculate activity coefficients for plutonia dissolved in urania and in thoria.

8136 (HEDL-SA—1832-FP) **Remote maintenance development.** Zook, C.R. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 16p. (CONF-7910106—1). Dep. NTIS, PC A02/MF A01.

From Society of Manufacturing Engineers conference; Detroit, MI, USA (29 Oct 1979).

The concept of remote maintenance as it pertains to nuclear fuel fabrication facilities is quite unique. The future may require completely remote facilities where maintenance will be performed by hybrid manipulators/robots. These units will be capable of being preprogrammed for automatic operation or manually operated with the operator becoming a part of the closed loop control system. These robots will mesh television, computer control, and direct force feedback manual control in a usable new concept of robotics.

8137 **Sintering nuclear fuel pellets.** Funke, P. (to ALKEM GmbH). US Patent 4,158,681. 19 Jun 1979. Priority date 19 Mar 1976, German, Federal Republic of (F.R. Germany), 10p.

The invention particularly refers to a new method and apparatus for sintering pellets of nuclear fuel oxides and mixtures of nuclear fuel oxides in a reducing furnace atmosphere under regulated exposure time to produce nuclear fuel oxides of desired oxygen content. The reduced pellets are cooled and sent to an intermediate station for checking or holding. The cooled pellets are sent through a sintering furnace where the exposure time is also regulated. Additional features are the independent control of the atmospheres and temperature as well as the humidity concentration in each furnace. Nitrogen gas may be used in the process. 17 claims.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 8178, 8187, 8885

8138 (GA-A—15595) **Availability calculations for nuclear material processing facilities.** Holder, N.D. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76SF71053. 15p. (CONF-791103—57). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Methods for developing reliability and maintainability information and integrating it into availability calculations useful in the design and development of nuclear fuel processing facilities are being investigated. Effective availability (actual productive time) is of greater interest than the more traditional operating availability. Actual productive time calculations allow more precise estimates of redundant equipment and surge storage needs. Judgmental estimates of relability and maintainability from personnel involved in equipment design can be used as interim data to guide developmental efforts. These data can be used in computer modeling of integrated process operations. Simulated process operations can be used to study the effects of various redundant equipment and surge storage configurations on plant effective availability.

8139 (HEDL-SA—1857) **Multiservice utility plug for remote fuel reprocessing.** Goldmann, L.H. Jr.; Jensen, D.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1979. Contract EY-76-C-14-2170. 11p. (CONF-791103—60). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

This paper presents the design of a multiservice utility plug and drive system to be used for reliably engaging and disengaging all utility connections automatically that serve large portable equipment modules. The modules are arranged into a fuel processing production line within the Fuels and Materials Examination Laboratory. The utility plugs allow the modules to be easily replaced, rearranged or removed for maintenance.

8140 (HEDL-SA—1931) **Dissolution of FFTF vendor fuel.** Lerch, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1979. Contract EY-76-C-14-2170. 26p. (CONF-791086—2). Dep. NTIS, PC A03/MF A01.

From US/United Kingdom information exchange on dissolution of nuclear fuel; Windscale, UK (16 Oct 1979).

Dissolution experiments were performed on FFTF vendor fuel (both mechanically mixed and coprecipitated) during 1974, 1975, and 1976. A marked improvement was noted in the completeness of fuel dissolution from 1974 to 1976. The reason for this is unknown but may have been attributable to slight changes in fuel fabrication conditions. In general, the bulk of the fuel pellets tested dissolved to greater than 99.9% in nitric acid alone.

8141 (HEDL-SA—1934) **Dissolution test for homogeneity of mixed oxide fuel pellets.** Lerch, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1979. Contract EY-76-C-14-2170. 21p. (CONF-791086—1). Dep. NTIS, PC A02/MF A01.

From US/United Kingdom information exchange on dissolution of nuclear fuel; Windscale, UK (16 Oct 1979).

Experiments were performed to determine the relationship between fuel pellet homogeneity and pellet dissolubility. Although, in general, the amount of pellet residue decreased with increased homogeneity, as measured by the pellet figure of merit, the relationship was not absolute. Thus, all pellets with high figure of merit (excellent homogeneity) do not necessarily dissolve completely and all samples that dissolve completely do not necessarily have excellent homogeneity. It was therefore concluded that pellet dissolubility measurements could not be substituted for figure of merit determinations as a measurement of pellet homogeneity. 8 figures, 3 tables.

8142 **Solids handling and fluidized-bed combustion techniques developed for an HTGR fuel reprocessing pilot plant.** Richards, P.C.; Rickman, W.S.; Young, D.T. (Gen at Co, San Diego, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 602-608(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A sequentially operated pilot plant for reprocessing high-temperature, gas-cooled nuclear reactor fuel, primarily graphite, has evolved out of a development program including tests of size reduction gravity and pneumatic solids handling and fluidized-bed combustion. Accomplishments include greater than 99% carbon burnup with fines recycle; reliable solids transport; automatic control and data acquisition.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 8174, 8970, 8971

8143 (AGNS—35900-1-1-49) **Studies and research concerning BNFP: advanced cask handling studies.** McCreery, P.N. (Allied-General Nuclear Services, Barnwell, SC (USA)). Oct 1979. Contract ET-78-C-09-1040. 75p. Dep. NTIS, PC A04/MF A01.

Cask turnaround times at loading and unloading sites can be improved by providing better working conditions, improved safety, reduced decontamination time, training, and where practical to do so, improved facility design. This report consists of treatments of several of these topics with the common goal of improving operational efficiency.

8144 (DPSP-AFR—79-6-3) **Status of Away From Reactor spent fuel storage program.** King, F.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jul 1979. Contract EY-76-C-09-0001. 6p. (CONF-791108—9). Dep. NTIS, PC A02/MF A01.

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

The Away From Reactor (AFR) Spent Fuel Program that the US Department of Energy established in 1977 is intended to preclude the shutting down of commercial nuclear power reactors because of lack of storage space for spent fuel. Legislation now being considered by Congress includes plans to provide storage space for commercial spent fuel beginning in 1983. Utilities are being encouraged to provide as much storage space as possible in their

existing storage facilities, but projections indicate that a significant amount of AFR storage will be required. The government is evaluating the use of both existing and new storage facilities to solve this forecasted storage problem for commercial spent fuel.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 8644

8145 (EGG-RE-M—78-034) **Migration of TRU-containing slag into candidate refractories for waste management.** Seymour, W.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1978. Contract EY-76-C-07-1570. 24p. Dep. NTIS, PC A02/MF A01.

Results of initial tests on transuranic migration into commercial refractories are reported. Five castable refractories and a plastic-bonded refractory were tested using the cup test method. Initial results indicate that castable materials will not survive conditions expected in the slagging pyrolysis unit; plastic refractories appear to have better performance. The major mechanism of migration into the tested refractories is pore penetration. Al_2O_3 and Al_2O_3-Cr_2O_3 phases appear resistant to chemical diffusion of transuranics. 2 figures, 16 tables.

8146 (UCRL—15143) **Radiological performance objectives for radioactive waste derived from public values. Final report PR 78-20-80R.** Watson, S.R.; Campbell, V.N.; Kuskey, K.P.; Feuerwerger, P.H. (Decisions and Designs, Inc., McLean, VA (USA)). May 1979. Contract W-7405-ENG-48. 174p. Dep. NTIS, PC A08/MF A01.

The study explored the feasibility of incorporating public values into technical guidelines for nuclear-waste management: to this end (1) a set of value judgments to be elicited from the public was developed; (2) mathematical models for translating those judgments into guidelines were constructed; (3) fifty-eight people were selected and interviewed; and (4) the results of the interviews were used with the mathematical models to demonstrate the calculation of guidelines. Our study tentatively shows that a decision-analytic approach to risk evaluation is a feasible way to incorporate public judgments as to the relative significance of the various possible consequences of a waste repository. An important outcome of the study, however, was to encounter and identify in practice several problems to resolve in the use of public values to develop guidelines. The major problems fall under six headings: (1) definition of the set of values to assess; (2) methodology of assessment; (3) ability of public to quantitate their judgments; (4) social-choice theory behind mathematical models; (5) compatibility of models and data; and (6) technical objectives.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 8166, 8901

8147 (CONF-791112—43) **Vitrification of high-level alumina nuclear waste.** Brotzman, J.R. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 10p. Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Borophosphate glass compositions have been developed for the vitrification of a high-alumina calcined defense waste. The effect of substituting SiO_2, P_2O_5 and CuO for B_2O_3 on the viscosity and leach resistance was measured. The effect of the alkali to borate ratio and the Li_2O:Na_2O ratio on the melt viscosity and leach resistance was also measured.

8148 (DOE/TIC—10228) **Evaluation and review of alternative waste forms for immobilization of high level radioactive wastes.** (Department of Energy, Aiken, SC (USA). Savannah River Operations Office). 20 Aug 1979. 27p. Dep. NTIS, PC A03/MF A01.

Objective was to review the relative merits and potential of eleven alternative waste forms being considered for the solidification and disposal of radioactive wastes. A numerical rating of the alternative waste forms was arrived at individually by peer review panel members taking into consideration nine scientific and nine engineering parameters affecting the long-term performance and production of waste forms. A group rating for the alternative forms was achieved by averaging the individiual scores and discussing the available data base. Three final ranking lists comparing: (A) Present Scientific Merits or Least Risk for Use Today; (B) Research Priority; and (3) Present and Potential Engineering Practicality were prepared by the Panel. Each waste form in the lists is assigned a value of either (1) Top Rank, (2) Intermediate Rank, or is assigned a value of either (1) Top Rank, (2) Intermediate Rank, or (3) Bottom Rank. Relative strengths and weaknesses of the alternative waste forms and recommendations for future program directions are discussed.

8149 (EUR—5785) **Comparative evaluation of radioactive materials management by different methods: Pt. 1. Quantitative comparison of the different methods used for the reduction of the volume of α contaminated solid wastes.** Ditterich, K.; Schneider, J. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1977. 22p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

In order to estimate the various strategies based on different system structures, a methodology is given. It is applied to the radioactive waste management systems. The base of the methodology is constituted of objective criteria to calculate the validity of the considered method. The validity of this method is demonstrated by application to the evaluation of processes for reducing the volume of Pu contaminated solid wastes.

8150 (JAERI-M—7852) **Present status of partitioning developments.** Nakamura, H.; Kubota, M.; Tachimori, S. (Japan Atomic Energy Research Inst., Tokyo). Sep 1978. 42p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

Evolution and development of the concept of partitioning of high-level liquid wastes (HLLW) in nuclear fuel reprocessing are reviewed historically from the early phase of separating useful radioisotopes from HLLW to the recent phase of eliminating hazardous nuclides such as transuranium elements for safe waste disposal. Since the criteria in determining the nuclides for elimination and the respective decontamination factors are important in the strategy of partitioning, current views on the criteria are summarized. As elimination of the transuranium is most significant in the partitioning, various methods available of separating them from fission products are evaluated.

8151 (RHO-SA—116) **Rapid petrographic differentiation of the major crystalline components of synthetic Hanford evaporator slurry.** Starr, J.L. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). May 1979. Contract EY-77-C-06-1030. 7p. (CONF-790666—6). Dep. NTIS, PC A02/MF A01.

From 34. Northwest regional meeting of the American Chemical Society; Richland, WA, USA (13 Jun 1979).

The four major crystalline components of these synthetic slurry samples were shown to be differentiable by examining their morphology, habits, and interference figures. Since morphology and habit are plainly visible under crossed Nichols and a full wave plate, and since observation of interference figures may be accomplished at the push of a button; differentiation between each of the major crystalline phases present in this system was performed rapidly while observing those same crystals microscopically. Finally, crystal growth was shown to be dramatically affected by the presence of complexants.

8152 (MLM—2663(TR)) **Combustion of waste in a 60-liter drum. Status report, March 1978.** Matteman, J. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 25 Oct 1979. Translation source information not available. 18p. Dep. NTIS, PC A02/MF A01.

A pilot experiment on combustion of wastes from nuclear power plants was conducted using a 60-liter drum in place of a 200-liter drum. It is possible to feed waste to it without producing smoke. Continuous stoking produces conditions approaching complete combustion. Volume reduction factors are 25 to 75. HCl and fly ash can be removed using a dry gas cleaning system. The use of the installation for low-level radwaste is discussed. (DLC)

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 8144, 8175, 8176, 8179, 8883, 8886, 9214, 9257, 9263, 9396, 9397

8153 (BARC—947) **Study of seepage beneath a model waste disposal crib.** Umesh Chandra; Balu, K.; Nagaraja, S.H.; Panikar, J.T. (Bhabha Atomic Research Centre, Bombay (India)). 1978. 27p. Dep. NTIS (US Sales Only), PC A04/MF A01.

For the proper evaluation of the safety aspects of disposal of radioactive liquid wastes through cribs, it is necessary to know seepage of liquid and total discharge beneath a crib. With this objective in view, seepage of liquid and total discharge beneath a model waste disposal crib has been studied taking into consideration the various parameters, namely, permeability of the subsurface strata; boundaries of the waste disposal site; depth and slope of the rock; water table - its depth, slope and fluctuations; level of liquid wastes in the crib and dimensions of the crib. Three approaches, namely, analytical, numerical and analog model simulations have been followed in the study. Exact analytical solution developed by using Schwarz-Christoffel transformation to compute discharge revealed the significant effect of crib width on discharge. Curves thus obtained are useful in predicting the discharge from a crib. Potential lines and stream lines (flownets) constructed theoretically by solving boundary value problem numerically using the computer code POTAL help in establishing migration route of the pollutants. Nu-

merical results of the flownets compare reasonably well with the experimentally observed plots. Conductive liquid model based on electrical analogy and Hele-Shaw model based on viscous flow analogy were set up in the laboratory experimentally to determine the flow nets and discharge, after simulating the field conditions in the model. The study is, however, more useful in a homogeneous viz., sandy aquifer, as there is a limitation to simulate varying permeability in a heterogeneous strata. Hele-Shaw model study reveals that for a given condition of the initial water table, the slope of the impervious bed has negligible effect on discharge and free surface slopes.

8154 (CONF-791112—45) **General criteria for radioactive waste disposal.** Maxey, M.N.; Musgrave, B.C.; Watkins, G.B. (Detroit Univ., MI (USA); Idaho National Engineering Lab., Idaho Falls (USA); New York State Dept. of Health, Albany (USA)). 1979. Contract EY-76-C-07-1570. 6p. Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Techniques are being developed for conversion of radioactive wastes to solids and their placement into repositories. Criteria for such disposal are needed to assure protection of the biosphere. The ALARA (as low as reasonably achievable) principle should be applicable at all times during the disposal period. Radioactive wastes can be categorized into three classes, depending on the activity. Three approaches were developed for judging the adequacy of disposal concepts: acceptable risk, ore body comparison, and three-stage ore body comparison. (DLC)

8155 (LA—8049-MS) **Preliminary concepts: materials management in an internationally safeguarded nuclear-waste geologic repository.** Ostenak, C.A.; Whitty, W.J.; Dietz, R.J. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 66p. Dep. NTIS, PC A04/MF A01.

Preliminary concepts of materials accountability are presented for an internationally safeguarded nuclear-waste geologic repository. A hypothetical reference repository that receives nuclear waste for emplacement in a geologic medium serves to illustrate specific safeguards concepts. Nuclear wastes received at the reference repository derive from prior fuel-cycle operations. Alternative safeguards techniques ranging from item accounting to nondestructive assay and waste characteristics that affect the necessary level of safeguards are examined. Downgrading of safeguards prior to shipment to the repository is recommended whenever possible. The point in the waste cycle where international safeguards may be terminate depends on the fissile content, feasibility of separation, and practicable recoverability of the waste: termination may not be possible if spent fuels are declared as waste.

8156 (LBL—9903) **Role of large-scale permeability measurements in fractured rock and their application at Stripa.** Witherspoon, P.A.; Wilson, C.R.; Long, J.C.S.; DuBois, A.O.; Gale, J.E.; McPherson, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Waterloo Univ., Ontario (Canada); Nottingham Univ. (UK)). Oct 1979. Contract W-7405-ENG-48. 11p. (CONF-791112—26). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Completion of the macropermeability experiment will provide: (i) a direct, in situ measurement of the permeability of 10^5 to 10^6 m^3 of rock; (ii) a potential method for confirming the analysis of a series of small scale permeability tests performed in surface and underground boreholes; (iii) a better understanding of the effect to open borehole zone length on pressure measurement; (iv) increased volume in fractured rock; (v) a basis for evaluating the ventilation technique for flow measurement in large scale testing of low permeability rocks.

8157 (PNL-SA—7992) **Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.** Bradley, D.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 234p. Dep. NTIS, PC A11/MF A01.

The reports from the workshop on waste form release rate analysis are presented. The workshop started with overview presentations on the Office of Nuclear Waste Isolation (ONWI), the Waste Isolation Safety Assessment Program (WISAP), WISAP Task 2 (Waste Form Release Rate Analysis), and WISAP Task 4 (Sorption/Desorption Analysis). Technical presentations followed in these areas: leaching studies on spent fuels, leaching studies on high-level waste glass, waste form surface science experiments, radiation effects, and leach modeling. Separate abstracts were prepared for each.

8158 (PNL-SA—7992, pp 1-10) **Overview of the Office of Nuclear Waste Isolation.** Kircher, J.F. (Office of Nuclear Waste Isolation, Columbus, OH). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

The role of the Office of Nuclear Waste Isolation (ONWI) is discussed. The 2 main goals are to identify and characterize geological sites for use as nuclear waste depositories and to manage the development and application of specific supporting data and base technologies. The specific means of carrying out these goals and an organizational chart are included.

8159 (PNL-SA—7992, pp 11-19) **Waste Isolation Safety Assessment Program.** Brandstetter, A. (Battelle Pacific Northwest Lab., Richland, WA). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

Associated with commercial nuclear power production in the United States is the generation of potentially hazardous radioactive wastes. The Department of Energy (DOE), through the National Waste Terminal Storage (NWTS) Program, is seeking to develop nuclear waste isolation systems in geologic formations that will preclude contact with the biosphere of waste radionuclides in concentrations which are sufficient to cause deleterious impact on humans or their environments. Comprehensive analyses of specific isolation systems are needed to assess the expectations of meeting that objective. The Waste Isolation Safety Assessment Program (WISAP) has been established at the Pacific Northwest Laboratory (operated by Battelle Memorial Institute) for developing the capability of making those analyses. The objectives of the Waste Isolation Safety Assessment Program (WISAP) are to: (1) develop the capabilities needed to assess the post-closure safety of geologic repositories, (2) obtain scientifically defensible generic and site-specific data necessary for safety assessments, (3) provide, as needed, studies to further support these data and analyses, (4) demonstrate the assessment capabilities by performing analyses of reference sites, (5) apply the assessment methodology to assist the National Waste Terminal Storage Program in site selection, and (6) perform repository site analyses responsive to the time schedule and to the level of sophistication required to meet the licensing needs of the National Waste Terminal Storage Program. Release scenario analysis, Task 1, is discussed.

8160 (PNL-SA—7992, pp 21-31) **Waste Isolation Safety Assessment Program. Task 2: waste form release rate analysis.** Bradley, D.J. (Battelle Pacific Northwest Lab., Richland, WA). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

The purpose of this task is to measure and understand radionuclide release rates for waste forms anticipated for geologic isolation. At the present time, these waste forms include spent fuel, High-Level Waste (HLW) glass, and for TRU, concrete, bitumen, urea-formaldehyde, and polymers. Radionuclide release processes are of major importance to breach consequence analyses because slower leach rates delay the transport of radionuclides from a breached repository to the biosphere. These processes are also responsible for determining the source term for migration away from the repository.

8161 (PNL-SA—7992, pp 33-43) **WISAP Task 4 (sorption-desorption analysis).** Serne, R.J. (Battelle Pacific Northwest Lab., Richland, WA). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

The overall objective of Task 4 is to provide the WISAP Task 3, release consequence analysis modelers the necessary information on long-term migration potential of leached nuclear wastes. The data being generated on nuclide sorption-desorption and precipitation-dissolution is obtained by both theoretical and experimental studies. At present only rock-nuclide interactions in the far-field (away from the waste induced heat and radiation fields) are under the preview of WISAP Task 4. The transport rate of nuclides is quantified by measurement of a parameter called Kd, the distribution coefficient. Kd is defind as the ratio of the amount of nuclide adsorbed on the solid media (rock) divided by the amount of nuclide remaining in the contacting solution (groundwater). This distribution, for each nuclide, can be dependent on the rock type, groundwater composition, nuclide concentration, nuclide valence state, and rock-nuclide contact time and surface area contacted. Presently the thrust of the Task 4 program is generic in nature. Until more direction and actual samples are available, work is being performed to gather data on nuclide-rock interactions for a wide range of rocks and groundwater types.

8162 (PNL-SA—7992, pp 45-66) **Non-flow release studies.** Bradley, D. (Battelle Pacific Northwest Lab., Richland, WA). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

Associated with commercial nuclear power production in the United States is the generation of potentially hazardous radioactive wastes. The Department of Energy (DOE), through the National Waste Terminal Storage (NWTS) Program, is seeking to develop nuclear waste isolation systems in geologic formations that will preclude contact with the biosphere of waste radionuclides in concentrations which are sufficient to cause deleterious impact on

humans or their environments. Comprehensive analyses of specific isolation systems are needed to assess the expectations of meeting that objective. The Waste Isolation Safety Assessment Program (WISAP) has been established at the Pacific Northwest Laboratory (operated by Battelle Memorial Institute) for developing the capability of making those analyses. The subtask with this title encompasses all the tests that are not run above 100°C, which falls into the Autoclave release subtask. Currently we are conducting IAEA and static leach tests in parallel on both spent fuel and cold and actinide doped waste glasses.

8163 (PNL-SA—7992, pp 67-71) **Autoclave release studies.** Westsik, J.H. Jr. (Battelle Pacific Northwest Lab., Richland, WA). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

Associated with commercial nuclear power production in the United States is the generation of potentially hazardous radioactive wastes. The Department of Energy (DOE), through the National Waste Terminal Storage (NWTS) Program, is seeking to develop nuclear waste isolation systems in geologic formations that will preclude contact with the biosphere of waste radionuclides in concentrations which are sufficient to cause deleterious impact on humans or their environments. Comprehensive analyses of specific isolation systems are needed to assess the expectations of meeting that objective. The Waste Isolation Safety Assessment Program (WISAP) has been established at the Pacific Northwest Laboratory (operated by Battelle Memorial Institute) for developing the capability of making those analyses. Among the analyses required for isolation system evaluation is the detailed assessment of the post-closure performance of nuclear waste repositories in geologic formations. The objective of this subtask is to examine the behavior of a high-level waste glass and spent fuel in aqueous solutions at high temperatures and pressures. By studying the waste water interactions we will (1) generate leach rate data, (2) gain some understanding of the kinetics and mechanisms of the interactions, (3) simulate long time, low temperature leaching, and (4) provide input to the leach model subtask.

8164 (PNL-SA—7992, pp 73-81) **Release model development.** Turcotte, R.P. (Battelle Pacific Northwest Lab., Richland, WA). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

Associated with commercial nuclear power production in the United States is the generation of potentially hazardous radioactive wastes. The Department of Energy (DOE), through the National Waste Terminal Storage (NWTS) Program, is seeking to develop nuclear waste isolation systems in geologic formations that will preclude contact with the biosphere of waste radionuclides in concentrations which are sufficient to cause deleterious impact on humans or their environments. Comprehensive analyses of specific isolation systems are needed to assess the expectations of meeting that objective. The Waste Isolation Safety Assessment Program (WISAP) has been established at the Pacific Northwest Laboratory (operated by Battelle Memorial Institute) for developing the capability of making those analyses. Among the analyses required for isolation system evaluation is the detailed assessment of the post-closure performance of nuclear waste repositories in geologic formations. The objective of this subtask is to develop a release model. Although leaching studies of nuclear waste glasses and other solid forms have been part of every development effort, we are not yet at a point where a defensible leach model can be presented. A major result of our work during the last year has been a clearer recognition that leaching models proposed previously, based on studies of simple glasses, are simply not applicable to typical nuclear waste glasses.

8165 (PNL-SA—7992, pp 93-111) **Leaching characteristics of actinides from simulated reactor waste glass.** Weed, H.C. (Lawrence Livermore Lab., CA); Coles, D.G.; Bradley, D.J.; Mensing, R.W.; Schweiger, J.S.; Rego, J.H. 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

This investigation is conducted for the Office of Nuclear Waste Isolation through Task 2 of the PNL Waste Isolation Safety Assessment Program (WISAP). One of the important goals of this program is to be able to calculate the rate of radionuclide release from candidate waste forms for geologic repository disposal. The present study has the following objectives in support of that goal: (1) to provide radionuclide source term information for use in release consequence analysis and migration rate calculations - this includes the effect of leaching, solution composition, flow rate, temperature, and time on the leach rate of simulated high level reactor waste glass; (2) to compare results obtained from the dynamic one-pass leaching method at LLL with those from the IAEA method at PNL. This progress report includes results to 120 days. Additional reports will be issued as the results are analyzed statistically, and a final report will be issued with PNL after the end of the experiments.

8166 (PNL-SA—7992, pp 113-146) **Leaching properties of solidified TRU waste forms (WBS element 0206).** Colombo, P.; Neilson, R.M. Jr. (Brookhaven National Lab., Upton, NY). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

Approximately 12 x 10^6 ft^3 of defense TRU wastes are in storage or burial at various DOE installations, principally at the Idaho National Engineering Laboratory (INEL), Hanford, and the Savannah River Plant. (Continued waste generation rates of 2 x 10^5 ft^3/yr are estimated.) These wastes will ultimately be moved and placed into a geologic repository for disposal. While there is some question as to whether existing TRU wastes will be disposed in their current form or first undergo some additiona volume reduction process, it is evident that volume reduction will be required for future TRU wastes. There are a number of volume reduction options available for combustible TRU wastes, the most viable option currently being some form of incineration. While incineration does result in a large volume reduction for combustible solid wastes, the ash that results is highly dispersible. As such, the immobilization of incinerator ash by solidification producing a solid monolithic waste form is desirable. Safety analysis of solidified TRU contaminated incinerator ash waste forms requires an estimate of the ability of these waste forms to retain activity in the disposal environment. The primary mechanism for the potential release of this activity is assumed to be by leaching. The experimental program conducted at Brookhaven National Laboratory will determine the leaching properties of TRU contaminated incinerator ash waste forms using hydraulic cement, urea-formaldehyde, bitumen, and vinyl ester-styrene as solidification agents. The data obtained will indicate the relative activity retention abilities of these waste forms and provide the basis for long-term release projections from full-scale waste forms.

8167 (PNL-SA—7992, pp 159-166) **Leaching U-Np-Pu-loaded simulated waste-glass.** Diamond, H.; Friedman, A. (Argonne National Lab., IL). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

Static leaching measurements were made in an oxygen-free environment. Three solutions, water, 0.3 M $NaHCO_3$ and brine were used; three intervals 2d, 8d, and 32d, and 23°C and 75°C temperatures were examined. The preliminary results show a varied response to temperature and some evidence that the leached material is not bound in siliceous fragments.

8168 (PNL-SA—7992, pp 167-179) **Spent fuel leach tests.** Katayama, B. (Battelle Pacific Northwest Lab., Richland, WA). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

This presentation is divided into two parts, pre-WISAP and WISAP. The pre-WISAP leach tests were started before WISAP sponsorship and do not give data directly applicable to the spent fuel release modeling studies being done in WISAP Task 2. However, the general leaching trends have suggested the general approach to some mechanistic studies. The WISAP portion of this presentation was started under WISAP sponsorship and is designed to fulfill the requirement of obtaining radionuclide release rates from spent fuel and understanding the radionuclide release process under simulated geologic storage conditions.

8169 (PNL-SA—7992, pp 205-229) **WIPP waste characterization and experimental programs.** Molecke, M.A. (Sandia Labs., Albuquerque, NM). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

The Waste Isolation Pilot Plant (WIPP) is intended to serve as a nuclear waste repository for those defense transuranic wastes, both contact-handled and remote-handled, which the Department of Energy (DOE) may designate as requiring deep geologic disposal. The WIPP will also provide a separate underground facility in which in-situ experiments with various waste forms, including high-level waste (HLW) and spent fuel, may be conducted. The DOE has also recommended (but not determined) that the WIPP be used to demonstrate the disposal of a limited number (no more than 1000) of spent fuel assemblies from commercial nuclear reactors. All the wastes, both TRU and spent fuel, placed into the WIPP for intended disposal would be retrievable for the periods required to demonstrate the validity of the disposal concept. These periods are not expected to exceed 10 years for TRU waste and 25 years for spent fuel. Wastes used in the experimental program will be removed at the conclusion of the experiments.

8170 (RHO-BWI—79-100-3Q) **Basalt Waste Isolation Program. Quarterly report, April 1, 1979-June 30, 1979.** Deju, R.A. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jul 1979. Contract EY-77-C-06-1030. 51p. Dep. NTIS, PC A04/MF A01.

During the quarter, progress was made in all areas of the Basalt Waste Isolation Program. In the Geosciences, Hydrology, and Engineered Barriers areas, work continued on schedule aimed at

being able to make a site selection decision in 1981, as scheduled. Emphasis continued to be placed on geologic mapping studies, on hydrologic data gathering, and on definition of waste/basalt interactions and needed engineered barriers. Progress at the end of the quarter on the Near-Surface Test Facility was approximately on schedule and the rate of work was accelerating to better than scheduled due to some equipment improvements and tunnel design modifications. In the Engineering Testing area, design work, test planning, and fabrication of heaters and auxiliary equipment continued on schedule. In the Repository area, an Architect/Engineer Evaluation Board was formally designed by the US Department of Energy-Headquarters during October 1978. The evaluation board will select an architect/engineer for repository conceptual design with an option for follow-on Title I, Title II, and Title III engineering services. Selection will be completed by October 1979. Questionnaire information was received from a number of interested architect/engineer firms by the US Department of Energy-Richland Operations Office and has been evaluated. Onsite visits with the qualified firms were completed during April 1979. In addition, repository preconceptual design studies continued on schedule with emphasis on compilation of repository functional design criteria by July 1979, and the repository preconceptual design report in September 1979.

8171 (SAND—79-0281) **Basic data report for drillhole WIPP 27 (Waste Isolation Pilot Plant).** (Sandia Labs., Albuquerque, NM (USA); Geological Survey, Denver, CO (USA)). Oct 1979. Contract EY-76-C-04-0789. 84p. Dep. NTIS, PC A05/MF A01.

WIPP 27 was drilled in Eddy County, New Mexico (NM 1/4 sec. 21, T21S, R30E) to investigate evaporite dissolution features and to determine the stratigraphy of surface and near-surface formations. The borehole encountered, from top to bottom, 79 feet of Quaternary deposits, 73 feet of the Rustler Formation, and 171 feet of the upper portion of the Salado Formation. Consecutive cores were obtained for the entire depth of WIPP 27. Geophysical logs measure acoustic velocities, density, radioactivity, and formation resistivity. An interpretive report on dissolution in Nash Draw will be based on combined borehole data, surface mapping and laboratory analyses of Nash Draw rocks and fluids.

8172 (SAND—79-0907C) **Geologic waste disposal and a model for the surface movement of radionuclides.** Helton, J.; Iman, R.; Brown, J.; Schreurs, S. (Sandia Labs., Albuquerque, NM (USA); Atomenergikommissionen, Copenhagen (Denmark); Nuclear Regulatory Commission, Washington, DC (USA)). 1979. Contract EY-76-C-04-0789. 8p. (CONF-791112—18). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

A model for the surface movement of radionuclides is presented. This model, which is referred to as the Pathways Model, was constructed in a NRC project to develop a methodology to assess the risk associated with the goelogic disposal of high-level radioactive waste. The methodology development involves work in two major areas: (a) models for physical processes, and (b) statistical techniques for the use and assessment of these models. The presentation of the Pathways Model involves topics from both areas.

8173 (SAND—79-1156) **Proceedings of the fourth annual Seabed Working Group Meeting, Albuquerque, New Mexico USA, March 5-7, 1979.** Anderson, D.R. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 223p. Dep. NTIS, PC A10/MF A01.

Objectives of the meeting were: (1) to review the technical status and policies of national programs regarding assessment of deep ocean bed disposal of high-level radioactive wastes; (2) to provide a forum for discussions, information exchange, and planning of future efforts; (3) to identify and coordinate research vessel cruises and experiments, and establish cooperative programs, and (4) to identify one-of-a-kind test facilities and consider multinational use of such facilities. Seven countries (Canada, France, Japan, Federal Republic of Germany, the Netherlands, the United Kingdom, and the United States) participated. A representative of the Commission of European Communities, Ispra Establishment, was also present. Papers submitted at the meeting, together with the reports of the Seabed Working Group Executive Committee and the individual task groups, are compiled in this document.

8174 (PNL-TR—378) **Statement by Dr. Ernst Albrecht on the provincial government's position regarding the planned nuclear waste disposal facility (NEZ) in Gorleben. Part II. Position taken by the Federal government regarding the policy statement by the Niedersachsen provincial government on the planned nuclear waste disposal facility in Gorleben.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). 6 Dec 1979. Translation source information not available. 15p. Dep. NTIS, PC A02/MF A01.

Questions regarding the safety and policy aspects of the proposed DWK waste disposal center in Gorleben are discussed. The position of the Niedersachsen provincial government is that the center should not be built; instead, the salt formations should be tested and interim fuel storage facilities provided. The response of the Federal government to the Niedersachsen statement is also listed.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 8159, 8160, 8161, 8162, 8163, 8164, 8165, 8172, 9062, 9256, 9257, 9263

8175 (ANL—79-30) **Studies of nuclear-waste migration in geologic media. Annual report, October 1977-September 1978.** Seitz, M.G.; Rickert, P.G.; Fried, S.M.; Friedman, A.M.; Steindler, M.J. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 70p. Dep. NTIS, PC A04/MF A01.

The first phenomenon studied is incomplete water-nuclide-rock reaction because of slow reaction kinetics. A kinetic factor derived from the experimental results for strontium migration through glauconite (a hydrous silicate) was expressed in terms of the linear flow rate of solution and can be used to predict migration due to solution flow at rates of 0 to about 12 cm/min (60 km/y). Continuous-flow infiltration experiments with americium in fissures gave results that are predicted by a migration model that includes kinetic factors measured in experiments with static fluids. The results suggest that kinetic factors are as important as equilibrium adsorption parameters in predicting nuclide migration. The second phenomenon studied was the amount of adsorbed nuclide not being proportional to the nuclide concentration in solution (nonlinear adsorption isotherm). For cesium adsorption on limestone, a nonlinear isotherm was found to occur in the range of initial cesium concentrations from about 10^{-3} to 10^{-9}M. This adsorption property was confirmed by results of column-infiltration experiments in which cesium migration through oolitic limestone was found to be sensitive to the amount of cesium in solution. The existence of a nonlinear isotherm precludes the use of a single partition value (K/sub D/) to describe cesium migration in limestone at cesium concentrations above about 10^{-9}M. Therefore, the effects of nonlinear isotherms are germane to nuclide migration. 24 figures, 6 tables.

8176 (SAND—79-0896C) **Sensitivity studies of the swift radionuclide transport model.** Campbell, J.E.; Langkopf, B.S.; Iman, R.L. (Sandia Labs., Albuquerque, NM (USA); INTERA Environmental Consultants, Inc., Houston, TX (USA)). 1979. Contract EY-76-C-04-0789. Pp. (CONF-791112—22). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

There are large uncertainties in the input waste depository. The aim of the sensitivity studies was to identify these uncertainties and to reduce the number of SWIFT transport calculations. The sensitivity analysis was applied to a hypothetical problem consisting of both a reference site containing a nuclear waste depository and a disruptive-event scenario for the possible release of radioactive materials to the biosphere. Results are presented for the total radionuclide discharge to a river in the 10^6-year time period following depository closure. (DLC)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 8154, 8637, 8642, 9257

8177 (RHO-SA—104) **Summary of the development of processes and procedures for decontamination & decommissioning (D & D) of a plutonium-contaminated facility.** Held, J.T. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 30 Jan 1979. Contract EY-77-C-06-1030. 10p. (CONF-790923—9). Dep. NTIS, PC A02/MF A01.

From Decontamination and decommissioning of nuclear facilities conference; Sun Valley, ID, USA (16 Sep 1979).

The development of processes and procedures for Decontamination and decommissioning of plutonium-contaminated facilities using the retired Redox Plutonium Concentration Facility (Building 233-S) as the demonstration project is described. Special emphasis is given to the technical planning and evaluation aspects of the project. The engineering effort required to carry the project from beginning to end is stressed. Since the production of ample documentation constitutes a major objective of this project, special attention is given to the refinement of written procedures as well as the development of processes.

8178 (SR—0980-10) **Wet and dry deposition and resuspension of AFCT/TFCT fuel processing radionuclides. Final report.** Slinn, W.G.N.; Katen, P.C.; Wolf, M.A.; Loveland, W.D.; Radke, L.F.; Miller, E.L.; Ghannam, L.J.; Reynolds, B.W.; Vickers, D. (Oregon State Univ., Corvallis (USA)). Sep 1979. Contract EY-77-S-09-0980. 529p. Dep. NTIS, PC A23/MF A01.

After short summary and introductory chapters, Chapter IV contains a critical analysis of available parameterizations for resuspension and for wet and dry removal processes and recommends interim parameterizations for use in radiation dose calculations. Chapter V describes methods and experimental results from field studies of in-cloud vs below-cloud scavenging, precipitation efficiency, and modifications of aerosols by clouds. In Chapter VI are contained descriptions of methods and results from four different approaches to the problem of measuring the dry deposition velocities of submicron aerosol particles depositing on vegetation. Chapter VII describes experimental results from a study of resuspension and weathering of tracer aerosol particles deposited on soil, grass and gravel; typical resuspension rates were found to be of the order of 10^{-6} s^{-1} and it is recommended that the concept of weathering be reassessed. In Chapter VIII, National Weather Service data are used to obtain Lagrangian statistics for use in a regional-scale study of wet and dry removal. Chapter IX develops new concepts in reservoir models for application at regional to global scales. In the final chapter are some comments about the results found in this study and recommendations for future research.

8179 (UCRL—15121) **Relative potential hazards of radioactive waste in various water systems.** Duffy, J.J.; Mealy, G.L. (Analytic Sciences Corp., Reading, MA (USA)). 15 Jun 1979. Contract W-7405-ENG-48. 74p. Dep. NTIS, PC A04/MF A01.

The potential hazard to man arising from the hypothetical release of radioactive spent fuel waste into various water systems has been evaluated. Radionuclide transport and human exposure were simulated for six water systems: a large Northwestern river, a small Northeastern river, a small Northwestern river, a large Central Region river, a lake with no outflow in an arid region, and an aquifer discharging directly into an ocean.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 8155, 8902, 8943, 8971

8180 (BNL—50991, pp 297-303) **Nuclear data for nuclear material safeguards.** Lemley, J.R. (Brookhaven National Lab., Upton, NY). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

Some requirements for improved basic nuclear data for nuclear material safeguards have been identified through discussions with US workers active in this field. With the exception of plutonium half-life data, improvements in basic nuclear data are generally of secondary importance compared to other concerns for improving the effectiveness of safeguards methods presently in use and under development. As the practice of safeguards in all phases of the nuclear fuel cycle becomes more routine, it should become possible to define needs for improved data more exactly and to assign priorities with longer-term significance.

8181 (CONF-7910112—1) **Isotope correlations and measurements in the United States.** Persiani, P.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From NEACRP meeting; Paris, France (1 Oct 1979).

Isotopic composition changes with burnup can be used in fuel management and international safeguards. Development of measurement systems for these isotope correlations is discussed. (DLC)

8182 (INIS-mf—4811) **Agreement between the Government of the Republic of Finland and the Government of Australia concerning the transfer of nuclear material between Finland and Australia.** 1978. 10p. Dep. NTIS (US Sales Only), PC A02/MF A01.

This Agreement between two non-nuclear weapon States was signed on 20 July 1978 under the Non-proliferation Treaty. It lays down that nuclear material may only be transferred to a body duly authorised by the recipient Party's appropriate Governmental Authority; such material may not be used for nuclear weapons or diverted to military purposes and is subject to IAEA safeguards and physical protection measures. Provision is made for regular consultation between both Parties on effective implementation of the Agreement which will remain in force for 30 years.

8183 (LA-UR—79-2760) **Americium assay instrument.** Marshall, R.S. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. (CONF-791049—17). Dep. NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

A simple in-line americium assay instrument (AAI) was installed at an americium recovery process area at LASL for use in process development and for providing process control information. The AAI counts 59.5-keV ^{241}Am gamma rays, using a NaI(Tl) detector and Eberline SAM II electronics. It has a useful range of 3 x 10^{-5} to 10 g Am/l and does not suffer from plutonium interference. Comparative analyses of samples assayed in the AAI and samples assayed by the LASL Analytical Laboratory show a combined relative standard deviation of 14%.

8184 (LA-UR—79-3191) **Materials accounting considerations for international safeguards in a light-water reactor fuels reprocessing plant.** Hakkila, E.A.; Cobb, D.D.; Dayem, H.A.; Dietz, R.J.; Kern, E.A.; Shipley, J.P. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 10p. (CONF-791117—6). Dep. NTIS, PC A02/MF A01.

From ANS topical conference; Kiawah Island, SC, USA (26 Nov 1979).

This paper summarizes the requirements and functions of materials measurement and accounting systems applicable to large (1500 metric tonnes heavy metal per year - MTHM/y) future reprocessing facilities as well as small (210 MTHM/y) plants that are presently under IAEA safeguards. The effectiveness of conventional and proposed improved measurement and accounting systems were compared using modeling, simulation, and analysis procedures. The study showed that conventional accountability can meet IAEA goal quantities and detection times in these reference facilities only for low-enriched uranium. Dynamic materials accounting may meet IAEA goals for detecting abrupt (1-3 wks) diversion of 8 kg of plutonium. Current or projected techniques cannot meet the one-year protracted diversion goal for plutonium if this goal is based on an absolute 8 kg quantity.

8185 (LA-UR—79-3205) **Evolution of safeguards systems design.** Shipley, J.P.; Christensen, E.L.; Dietz, R.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-791117—8). Dep. NTIS, PC A02/MF A01.

From ANS topical conference; Kiawah Island, SC, USA (26 Nov 1979).

Safeguards systems play a vital detection and deterrence role in current nonproliferation policy. These safeguards systems have developed over the past three decades through the evolution of three essential components: the safeguards/process interface, safeguards performance criteria, and the technology necessary to support effective safeguards. This paper discusses the background and history of this evolutionary process, its major developments and status, and the future direction of safeguards system design.

8186 (NUREG/CR—1166) **COPS model estimates of LLEA availability near selected reactor sites.** Berkbigler, K.P. (Sandia Labs., Livermore, CA (USA)). Nov 1979. Contract EY-76-C-04-0789. 29p. (SAND—79-8261). Dep. NTIS, PC A03/MF A01.

The COPS computer model has been used to estimate local law enforcement agency (LLEA) officer availability in the neighborhood of selected nuclear reactor sites. The results of these analyses are presented both in graphic and tabular form in this report.

8187 (STI/PUB—497(Vol.2)) **Nuclear safeguards technology 1978. Volume II.** (International Atomic Energy Agency, Vienna (Austria)). Jul 1979. 848p. (CONF-781007—(Vol.2)). IAEA.

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

Texts of papers presented at the following sessions are contained in this volume: destructive and non-destructive measurement technology; safeguards data evaluation; advanced materials control concepts and systems; thorium/uranium-233 fuel cycles; and spent fuel reprocessing.

8188 **Technical consideration of the use of nuclear fuel spikants for proliferation deterrence.** Selle, J.E.; Angelini, P.; Rainey, R.H.; Federer, J.I.; Olsen, A.R. (Oak Ridge National Lab., TN). *Nucl. Technol.;* **45**: No. 3, 269-286(Oct 1979).

The use of a gamma active radionuclide with nuclear fuel has been proposed as a way to inhibit unauthorized diversion of the fuel and thus provide proliferation deterrence. Proposed dose rate ranges have varied from small additions to increase detectability of diverted material up to large additions to provide lethal doses in a relatively short exposure time. Some of the practical aspects of incorporating spikants into nuclear fuel are examined in an attempt to identify any technically adverse consequences of their use. The list of candidate spikants was narrowed to ^{60}Co, ^{106}Ru, and ^{144}Ce. Following this, the practical aspects of the use of these three spikants in nuclear fuel were investigated. Among the subjects considered are dose rates available from fuel elements, fission product buildup, chemical behavior of spikants during reprocessing, and possible effects of spikants on refabrication and on the fuel properties. Neither ^{106}Ru nor ^{144}Ce is present in sufficient quantity to produce the maximum radiation dose rate level considered. Nonradioative nuclides of ruthenium and cerium dilute the radioactive nuclides to 2 to 4% of the total element in the fission products 2 yr after removal from the reactor. Recycling ruthenium and cerium will result in dilution of

the radionuclides even further by a buildup of stable isotopes of each of these elements. Approximately 50% of the fission product ruthenium and 3 to 5% of the cerium can be coprocessed with the fuel, while cobalt cannot be coprocessed at all. No single radionuclide was found to be preferred in all stages of reprocessing and refabrication. To provide deterrence in all stages of reprocessing and refabrication, a duplex spiking process appears necessary, in which two different spikants, ^{106}Ru and ^{60}Co, are used in different portions of reprocessing. The use of nominal amounts of ruthenium or cobalt as spikants is not expected to adversely affect fuel performance.

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 8643

FUSION FUELS

PROCESSING

REFER ALSO TO CITATION(S) 8989

BY-PRODUCTS

8189 Fusion energy: the iceberg beneath the tip. Williams, J.M.; Airey, J.R.; Bogart, S.L.; Cullingford, H.S. (US DOE, Washington, DC). pp 2389-2410 of Alternative energy sources. Vol. 5. Veziroglu, T.N. (ed.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

The United States fusion programs have recently placed greater emphasis on nonelectrical applications of the fusion process. This recognition resulted from four fundamental observations: without a substantial change in end use technologies, the major energy demand will continue to feature chemical fuels and not electricity; the industrialization of developing countries may require developed countries to turn to advanced energy technologies at an early date, thus permitting developing countries access to conventional energy supplies; the fusion process is unique in that it can support of substitute for advanced energy technologies such as nuclear fission and synthetic chemical fuel production. Furthermore, the fusion process may offer sufficient flexibility to supply energy in efficient and noncontroversial ways; and the prospects for the success of fusion are sufficiently high that serious efforts be made to determine its ultimate roles in the world's energy supply system. As a result, programs have been initiated to assess the feasibility of all fusion energy applications. Initially the focus is on fusion-fission energy systems that may offer the proliferation resistance sought by the world today and on the production of synthetic chemical fuels.

8190 Production of synthetic fuels: an important civilian application of laser fusion. Meinke, W.W.; Gomberg, H.J. (KMS Fusion, Inc, Ann Arbor, Mich). pp 2563-2574 of Alternative energy sources. Vol. 5. Veziroglu, T.N. (ed.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

Present baseline laser-fusion reactor designs emphasize the conversion of the energetic particles released in fusion to heat, and thence to electrical energy via traditional turbine technology. The authors have found, however, that direct utilization of fusion radiations to generate hydrogen/methane can provide an effective alternative to the generation of electricity. In laser fusion the simple geometric arrangement, whereby fusion occurs in a small pellet of approximately one millimeter diameter, will produce very large fluxes of 14-MeV neutrons emanating in all directions. These energetic neutrons can interact with chemical systems in a radiolysis process, combining radiolysis and thermally driven reactions. Hydrogen can then be incorporated into methane for pipeline use or into methanol for use in automobiles.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 8903

8191 Waste management strategy for nuclear fusion power systems from a regulatory perspective. Heckman, R.A. (Univ of Calif, Lawrence Livermore Lab). pp 2521-2539 of Alternative energy sources. Vol. 5. Veziroglu, T.N. (ed.). Washington, DC; Hemisphere Publishing Corp. (1978)

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

A waste management strategy for future nuclear fusion power systems is developed using existing regulatory methodology. The first step is the development of a reference fuel cycle. Next, the waste streams from such a facility are identified. Then a waste management system is defined to handle and dispose safely of these wastes. The future regulator must identify the decisions necessary to establish waste management performance criteria. The data base and methodologies necessary to make these decisions must then be developed. Safe management of nuclear fusion wastes is not only a technological challenge, but encompasses significant social, political, and ethical questions as well.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

RADIATION SOURCES

OTHER INDUSTRIAL USES

8192 (AD-A—070862) **Radioisotope tracer technique of measuring absorption of paint driers by pigments. Final report, July 1975-September 1978.** Matsui, E.S. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Mar 1979. 61p. NTIS PC A04/MF A01.

A sensitive radioisotope tracer technique to measure the amount of paint drier adsorbed on paint pigments has been developed. This technique was found to be very sensitive and precise, and reliability and reproducibility of the procedure were very good. The laboratory results indicated that paint driers were adsorbed by pigments during storage, and the amount of adsorption varied among the paints.

8193 (STI/PUB—501) **Isotopes and radiation in research on soil-plant relationships.** (International Atomic Energy Agency, Vienna (Austria)). Oct 1979. 670p. (In several languages). (CONF-781227—). IAEA.

From Symposium on the use of isotope and radiation in research on soil-plant relationships; Colombo, Sri Lanka (11 Dec 1978).

Separate abstracts have been prepared for individual papers. (TFD)

ISOTOPIC POWER SUPPLIES

REFER ALSO TO CITATION(S) 8750, 8752

DESIGN AND FABRICATION

8194 (TES—33009-44) **Selenide isotope generator for the Galileo Mission: copper/water axially-grooved heat pipe topical report.** Strazza, N.P. (Teledyne Energy Systems, Timonium, MD (USA)). 30 Jun 1979. Contract ET-78-C-01-2865. 136p. Dep. NTIS, PC A07/MF A01.

This report presents a summary of the major accomplishments for the development, fabrication, and testing of axially-grooved copper/water heat pipes for Selenide Isotopic Generator (SIG) applications. The early development consisted of chemical, physical, and analytical studies to define an axially-grooved tube geometry that could be successfully fabricated and provide the desired long term (up to seven years) performance is presented. Heat pipe fabrication procedures, measured performance and accelerated life testing of heat pipes S/Ns AL-5 and LT-57 conducted at B and K Engineering are discussed. S/N AL-5 was the first axially-grooved copper/water heat pipe that was fabricated with the new internal coating process for cupric oxide (CuO) and the cleaning and water preparation methods developed by Battelle Columbus Laboratories. Heat pipe S/N LT-57 was fabricated along with sixty other axially-grooved heat pipes allocated for life testing at Teledyne Energy Systems. As of June 25, 1979, heat pipes S/Ns AL-5 and LT-57 have been accelerated life tested for 13,310 and 6,292 respectively, at a nominal operating temperature of 225°C without any signs of thermal performance degradation. (TFD)

8195 (TES—33009-45) **Selenide isotope generator for the Galileo Mission: heat pipe attachment technology final report.** (Teledyne Energy Systems, Timonium, MD (USA)). Jul 1979. Contract ET-78-C-01-2865. 56p. Dep. NTIS, PC A04/MF A01.

The development of an optimum joining method for attaching copper/water heat pipes to an aluminum alloy (6061-T6) radiator and housing for the SIG/Galileo Program is described.

8196 (TES—33009-47) **Selenide isotope generator for the Galileo Mission: SIG/Galileo hermetic receptable test program final report.** Roedel, S. (Teledyne Energy Systems, Timonium, MD

(USA)). Jun 1979. Contract ET-78-C-01-2865. 159p. Dep. NTIS, PC A08/MF A01.

The purpose of the receptacle test program was to test various types of hermetically sealed electrical receptacles and to select one model as the spaceflight hardware item for SIG/Galileo thermoelectric generators. The design goal of the program was to qualify a hermetic seal integrity of $\leq 1 \times 10^{-9}$ std cc He/sec -atm at 400°F (204°C) and verify a reliability of 0.95 at a 50% confidence level for a flight mission in excess of 7 years.

8197 (TES—33009-50) **Selenide isotope generator for the Galileo Mission: SIG thermal insulation evaluaion tests.** (Teledyne Energy Systems, Timonium, MD (USA)). Jun 1979. Contract ET-78-C-01-2865. 60p. PC A04/MF A01.

Since the SIG program required the use of very high performance thermal insulation materials in rather severe thermal and environmental conditions, a thorough screening and testing program was performed. Several types of materials were included in the preliminary survey. Most promising were oxide and carbonaceous fibrous insulations, oxide and carbonaceous foamed materials, and multilayer materials with both powder and cloth spacers. The latter were only viable for the vacuum option. In all, over one hundred materials from more than sixty manufacturers were evaluated from literature and manufacturers' data. The list was pared to eighteen candidates in seven basic types, i.e., fibrous microporous SiO_2, fibrous SiO_2/Al_2O_3, fibrous ZrO_2, fibrous carbon, foamed SiO_2, foamed carbon, and multilayer. Test results are presented.

8198 (TES—33009-51) **Selenide isotope generators for the Galileo Mission: SIG hermetic bimetal weld transition joint.** Barnett, W.J. (Teledyne Energy Systems, Timonium, MD (USA)). Aug 1979. Contract ET-78-C-01-2865. 79p. Dep. NTIS, PC A05/MF A01.

The successful development of the commercial 6061-T651/Silver/304L explosive clad plate material as a bimetal weld transition joint material, as described herein, satisfies all SIG Galileo design requirements for hermetic weld attachment of stainless steel subassemblies to aluminum alloy generator housing or end cover structures. The application of this type weld transition joint to the hermetic attachment of stainless steel shell connectors is well-developed and tested. Based on on-going life tests of stainless steel receptacle/bimetal ring attachment assemblies and metallurgical characterization studies of this transition joint material, it appears evident that this transition joint material has more than adequate capability to meet the 250 to 300°F and 50,000 hr. design life of the SIG/Galileo mission. Its extended life temperture capability may well approach 350 to 400°F.

8199 **Copper/water axially-grooved heat pipes for rtg applications.** Strazza, N.; Brennan, P.J.; Nguyen, N.H. (Teledyne Energy Syst, Timonium, Md). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1707-1711(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The use of heat pipes for enhancing the overall heat rejection capability of the radiative fins of a Radioisotope Thermoelectric Generator (RTG) offers significant weight savings for these systems. Copper/water heat pipes are best suited for these applications because of the associated operating temperature range and materials compatibility considerations. However, previous experience with copper/water heat pipes has shown that long term materials compatibility is a problem particularly when temperatures exceed 150°C. The paper presents a discussion of copper/water RTG heat pipe experience and describes the development of oxide coated axially-grooved copper/water heat pipes which have demonstrated more than 8000 hours of continuous operation at 225°C with no gas generation attributable to chemical incompatibility.

8200 **High temperature insulations for radioisotope thermoelectric generators.** Skrabek, E.A. (Teledyne Energy Syst, Timonium, Md). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1712-1716(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The environmental requirements of the Selenide Isotope Generator have led to a thorough evaluation of all available high temperature thermal insulation materials and the development of some new ones. This paper reports primarily on the results of thermal conductivity and load bearing experiments performed on a series of fibrous and cellular insulation materials capable of operating at hot face temperatures in the 800° to 1000°C range. The thermal conductivities of fourteen materials were determined using the guarded hot plate technique. All of the materials were tested in a vacuum environment, most were tested in helium, and a few were checked in xenon. The load relaxation characteristics of the end plug materials were determined using two different techniques.

USES

REFER ALSO TO CITATION(S) 8755

HYDROGEN

REFER ALSO TO CITATION(S) 8727, 8728

PRODUCTION

REFER ALSO TO CITATION(S) 8913

8201 (COO—2708T012-3) **Hydrogen as a fuel.** (National Research Council, Washington, DC (USA). Committee on Advanced Energy Storage Systems). 1979. Contract EY-76-C-02-2708-012. 78p. Dep. NTIS, PC A05/MF A01.

A panel of the Committee on Advanced Energy Storage Systems of the Assembly of Engineering has examined the status and problems of hydrogen manufacturing methods, hydrogen transmission and distribution networks, and hydrogen storage systems. This examination, culminating at a time when rapidly changing conditions are having noticeable impact on fuel and energy availability and prices, was undertaken with a view to determining suitable criteria for establishing the pace, timing, and technical content of appropriate federally sponsored hydrogen R & D programs. The increasing urgency to develop new sources and forms of fuel and energy may well impact on the scale and timing of potential future hydrogen uses. The findings of the panel are presented. Chapters are devoted to hydrogen sources, hydrogen as a feedstock, hydrogen transport and storage, hydrogen as a heating fuel, automotive uses of hydrogen, aircraft use of hydrogen, the fuel cell in hydrogen energy systems, hydrogen research and development evaluation, and international hydrogen programs.

8202 (TAC-H—79-001) **Hydrogen energy: a bibliography with abstracts. Quarterly update, January-March 1979.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Apr 1979. 57p. University of New Mexico, Technology Application Center, Albuquerque, NM 87131.

This bibliography contains 149 citations on the subject of hydrogen as a secondary fuel and as an energy carrier, production, utilization, transmission, distribution, storage, safety, and materials are covered.

8203 **Hydrogen production and delivery today: central liquefaction to the customer's facility.** Francis, A.W. (Union Carbide, Tarrytown, NY). pp 65-71 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The history of the liquid hydrogen industry is covered briefly.

8204 **Overview of the STOR hydrogen energy program.** Berger, B.J. (Dept. of Energy, Washington, DC); Standley, W.R. pp 72-86 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

A brief description of the program areas within the Chemical and Technical Branch, Division of Energy Storage Systems, Department of Energy, is provided. These areas are production, storage, transmission/distribution, and conversion/end-use.

ELECTROLYSIS

REFER ALSO TO CITATION(S) 8074, 8284

THERMOCHEMICAL PROCESSES

8205 **Catalysis of hydrogen production in irradiated aqueous solutions by gold sols.** Meisel, D. (Argonne National Lab., IL). *J. Am. Chem. Soc.;* **101**: No. 20, 6133-6135(26 Sep 1979).

The 2-propanol radical was produced by γ-irradiation of aqueous solutions containing 0.13M propanol and 0.13M acetone. Results are summarized for the effect of gold sols on the hydrogen yield at different doses and dose rates. A substantial increase in the yield of hydrogen can be achieved if all of the alcohol radicals are used up in the reaction. It was demonstrated that finely dispersed gold particles would catalyze hydrogen formation from a radical which would otherwise disproportionate or dimerize in a diffusion-controlled system. In the particular example studied, the effect of the radiation is to produce hydrogen from water with a yield close to that theoretically possible, with the conversion of 2-propanol into acetone. High energy fluxes favor the hydrogen process over low-energy flux conditions.

8206 Studies on thermochemical water-splitting cycles. Remick, R.J.; Foh, S.E. Chicago, IL; Institute of Gas Technology (1979). 5p. (CONF-791127—7).

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

Thermochemical water-splitting cycles that use solid metal sulfates instead of sulfuric acid appear to offer the advantage of allowing the electrolytic oxidation of sulfurous acid to take place in relatively dilute solutions where anodic overpotential is expected to be minimized. The Institute of Gas Technology is investigating such systems in order to define preferred operating conditions and performance for the electrolytic step. The current-voltage characteristics of smooth platinum for the oxidation of sulfur dioxide (SO_2) to sulfuric acid and the reduction of hydronium ions to hydrogen were determined at acid concentrations between 1 and 50 weight percent and over the temperature range from 1° to 75°C. At a constant applied overpotential, the current density for hydrogen generation increases with increasing acid concentration. With a given applied anodic overpotential, the rate of SO_2 electrochemical oxidation decreased somewhat with increasing acid concentration. In general, current densities at a given overpotential increased with temperature at both electrodes. However, at high temperature and anodic overpotential, the rate for SO_2 oxidation decreased over that expected, presumably a consequence of the temperature dependence of the SO_2 concentration. The electrochemical performance of smooth platinum was observed to degrade at anodic potentials above 0.80 volts vs RHE. This degradation could be the result of either oxide formation or preferential adsorption of sulfate ions on the catalytic platinum surface.

WATER GAS PROCESSES

8207 Homogeneous catalysis of the water gas shift reaction by rutheuium and other metal carbonyls: studies in alkaline solutions. Ungermann, C.; Landis, V.; Moya, S.A.; Cohen, H.; Walker, H.; Pearson, R.G.; Rinker, R.G.; Ford, P.C. (Univ. of California, Santa Barbara). *J. Am. Chem. Soc.;* **101**: No. 20, 5922-5929(26 Sep 1979).

Homogeneous catalysis of the water gas shift reaction (H_2O + CO reversible H_2 + CO_2) has been demonstrated for a number of metal carbonyl complexes under alkaline conditions. Characterization of the catalysts based on ruthenium carbonyl in alkaline, aqueous ethoxyethanol solution demonstrates that the principal species present under the reaction conditions are the carbonyl hydride anions $H_3Ru_4(CO)_{12}^-$ and $HRu_3CO)_{11}^-$. (The room temperature synthesis of the latter ion by the reaction of $Ru_3(CO)_{12}$ in alcoholic KOH is described). The catalysis rate shows a first-order dependence on both the CO partial pressure and the total ruthenium concentration. Cyclic mechanisms proposed to explain these observations involve nucleophilic attack of water or of hydroxide on coordinated CO followed by decarboxylation to give hydridic species from which H_2 is eliminated in a CO-assisted, rate-limiting step. It is noted that catalysts prepared by adding both iron and ruthenium carbonyls to the same solution are more active than either the ruthenium-based or the iron-based catalysts alone. These mixed metal catalyst solutions are shown to contain mixed metal clusters, and it is proposed that the synergetic effect on catalytic activity may result from greater reactivity of the mixed metal clusters toward elimination of dihydrogen.

BIOSYNTHESIS AND PHOTOCHEMICAL PROCESSES

8208 (SAN—0034-239-1) **Solar energy conversion through biophotolysis. Final report, April 1, 1977-March 31, 1978.** Benemann, J.R.; Hallenbeck, P.C.; Murry, M.A.; Kochian, L.V.; Miyamoto, K.; Kostel, P.J. (California Univ., Berkeley (USA). Sanitary Engineering Research Lab.). 1 Sep 1978. Contract EY-76-S-03-0034-239. 249p. (UCB/SERL—78-8). Dep. NTIS, PC A11/MF A01.

Biophotolysis has been demonstrated using nitrogen-starved cultures of the blue-green alga Anabaena cylindrica. Individual chapters are devoted to: a review of literature on hydrogen from algae; development of the biophotolysis system; thermophilic blue-green algae; characterization and partial purification of the reversible hydrogenase; purification and properties of nitrogenase; studies with an antibody specific to nitrogenase; nitrogenase regulation in Anabaena cylindrica; and hydrogen production with photosynthetic bacteria.

STEAM-IRON PROCESS

REFER ALSO TO CITATION(S) 8766

8209 (FE—2435-39) **Development of the steam-iron process for hydrogen production. Project 70102 quarterly report No. 9, July 1-September 30, 1978.** (Institute of Gas Technology, Chicago, IL (USA)). Aug 1979. Contract EX-76-C-01-2435. 95p. Dep. NTIS, PC A05/MF A01.

The Reactor System Start-up task was completed. Under the Reactor System Variables Study task a number of significant new milestones were achieved which furthered the development of the steam-iron program: three highly successful hydrogen-producing tests and a data analysis for another test were completed. Test 18, the fourth consecutive hydrogen-producing test, was completed in July. The operating period lasted 16 days and included 153 hours of ore circulation and 9 hours of self-sustained hydrogen production. Smooth ore circulation was demonstrated for an extended period of time at pressures between 400 and 500 psig. The fifth and sixth consecutive hydrogen-producing tests were conducted in September. In Test 19, reactor pressure was increased to 500 psig during hydrogen production, and the highest hydrogen concentration in the product gas, to date, was obtained. The longest hydrogen-producing period (130 hours) was achieved in Test 20. Testing was discontinued on September 30. The data analysis for Test 17 is presented.

8210 Development status of the Steam-Iron Process for hydrogen production. Biljetina, R.; Tarman, P.B. Chicago, IL; Institute of Gas Technology (1979). 14p. (CONF-791204—8).

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

A description of the Steam-Iron Process for hydrogen production and operating results from a large-scale pilot facility are presented. Significant achievements of the pilot plant program are discussed. Commercial applications and economic advantages of the process are presented.

STORAGE

REFER ALSO TO CITATION(S) 8201, 8202, 8204

CHEMISORPTION

REFER ALSO TO CITATION(S) 8860, 8861, 8863, 8881, 8884

8211 (INKA-Conf—79-042-000(Vol.2), pp 572-583) **Study of the diffusion of hydrogen in potential hydrogen storage materials.** Lebsanft, E.; Richter, D.; Toepler, J.M. (Institut fuer Festkoerperforschung der KFA Juelich GmbH, Germany). 1979.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

The proton diffusion in the intermetallic compounds Ti_2NiH_2, FeTiH, and $LaNi_5H_6$ was investigated by means of quasielastic neutron scattering. The diffusion coefficient of hydrogen in FeTiH was measured in the high temperature range $633 \leqq T \leqq 759$ K and was found to obey an Arrhenium law $D = (7.2 \pm 3.6) \cdot 10^{-4} \times \exp - [(0.5 \pm 0.05)\ eV]/(kT)\ cm^2/s$. The diffusion constant obtained for H in Ti_2NiH_2 in the temperature region $428 \leqq T \leqq 523$ K is $D = (2 \pm 1) \times 10^{-4} \times \exp - [(0.345 \pm 0.045)\ eV]/(kT)\ cm^2/s$. The diffusion of hydrogen in $LaNi_5H_6$ was studied in the temperature range $248 \leqq T \leqq 318$ K and is much faster than in the other two compounds. A value of $D = (1.5 \pm 0.2) \cdot 10^{-5} \times \exp - [(0.154 \pm 0.021)\ eV]/(kT)\ cm^2/s$ was found.

8212 (INKA-Conf—79-042-000(Vol.2), pp 635-655) **How FeTi absorbs hydrogen.** Schlapbach, L. (Eidgenoessische Technische Hochschule, Zuerich, Switzerland); Seiler, A.; Stucki, F.; Zuercher, P. 1979.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

The surface and magnetic properties of FeTi and their variation upon heat treatment and hydrogenation were investigated by means of XPS, AES, and spin polarized photoemission and magnetic susceptibility measurements. The structure of FeTiD was investigated by means of the neutron diffraction technique. The activation process, poisoning with oxygen and reactivation, the oxygen sealing of the hydrided FeTi and the irreversible change of the magnetic properties upon hydrogenation are explained by surface segregation and decomposition of the orginial surface.

8213 (INKA-Conf—79-042-000(Vol.2). pp 656-665) **Hydrogen sorption in amorphous Ni(Zr,Ti)-alloys.** Spit, F.H.M.; Drijver, J.W.; Radelaar, S. (State Univ. Utrecht, Netherlands). 1979.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

Hydrogen adsorption and desorption were studied in $Ni_{64}Zr_{36}$ and $Ni_{62}Ti_{29}Zr_9$, obtained in the amorphous state by melt spinning, and in crystalline $NI_{64}Zr_{36}$. Pressure-composition isotherms were measured with a volumetric method. The isotherms of the amorphius alloys did not exhibit a pressure plateau. The hydrogen-to-metal ratio H/M of amorphous and crystalline $Ni_{64}Zr_{36}$ at a hydrogen pressure of 3.4 MPa and a temperature of 333 K were found to be 0.54 and 0.66 respectively. In none of the isotherms measured Sieverts' Law is obeyed. The ribbons remained amorphous upon hydriding and dehydriding as shown by x-ray and caloric measurements (DSC-2). Upon hydrogen absorption the amorphous ribbons increased with about 3.5% in length and width. The ribbons became brittle but did not pulverize, in contrast to the crystalline alloy. The

hydrogen sorption rate of the crystalline material was somewhat larger than that of the amorphous ribbons.

8214 (INKA-Conf—79-042-000(Vol.2), pp 666-673) **Relation between electronic structure and hydrogen storage properties of intermetallic compound.** Peretz, M. (Soreq Nuclear Research Centre, Yayne, Israel); Zamir, D.; Shaltiel, D.; Shinar, J. 1979.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

The approach, undertaken in the present work, is to find expermentally relationships between electronic structure parameters and the parameters which characterize the hydrogen affinity of the intermetallic compounds. These relationships were investigated in the pseudobinary Zr(Y/sub 1-x/Co/sub x-2/) system by using the nuclear magnetic resonance technique.

8215 (INKA-Conf—79-042-000(Vol.2), pp 700-711) **Calorimetric enthalpies for solution of hydrogen in the $LaNi_5$-H system.** Bowerman, B.S.; Wulff, C.A.; Flanagan, T.B. (Univ. of Vermont, Burlington). 1979.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

Relative partial enthalpies for absorption (desorption) of H_2 by $LaNi_5$ have been determined at 298 K over the range of H contents from $H/LaNi_5 \sim 0$ to 6.4. The relative partial enthalpy of H_2 solution decreases in exothermicity from $H/LaNi_5 \sim 0$ to 0.23 and then is nearly constant with H content to the lower phase boundary. The enthalpy corresponding to the formation of the hydride phase from the H-saturated solid and $1/2H_2$ is -14.8 +- 0.5 $kJ(mol\ H)^{-1}$ and this value is within experimental error of the values of the partial enthalpies in single phase regions adjacent to the phase boundaries. The relative partial enthalpy for H_2 solution in the hydride phase becomes increasingly exothermic with H content.

UNDERGROUND

8216 (SAND—79-8647) **Fixed site hydrogen storage. I. Applications impact.** Iannucci, J.J.; Robinson, S.L. (Sandia Labs., Livermore, CA (USA)). 1979. Contract EY-76-C-04-0789. 11p. (CONF-791204—10). Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

The potential applications and requirements for fixed site storage in a scenario of wide spread hydrogen use are examined and quantified. An envisioned hydrogen production/distribution/end-use cycle is scrutinized to identify the storage needs for both continuous and intermittent sources including solar. The most pressing need for storage is found to be at the distribution point, in concurrence with current natural gas practice. Caverns and similar underground storage techniques are shown to be the most promising modes due to their low cost relative to all other options examined. Since a large volume of natural gas storage is presently in service, a pressing need to develop fixed site hydrogen storage technology (beyond the conversion of this underground storage to hydrogen) has not been identified.

CRYOGENIC

8217 **Space shuttle: bringing cryohydrogen technology down to earth.** Odom, J.B. (National Aeronautics and Space Administration, Huntsville, AL). pp 111-126 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The evolution of the Space Shuttle System is discussed. The configuration selected includes four elements of which three are reusable. The unique problems, solutions, and design features imposed on the external tank by the cyrogenic propellants are covered.

TRANSPORT

REFER ALSO TO CITATION(S) 8201, 8202, 8204

8218 **Study of the behavior of gas distribution equipment in hydrogen service, Phase II.** Jasionowski, W.J.; Huang, H.D. Chicago, IL; Inst. of Gas Technology (1979). 6p. (CONF-791127—6).

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

IGT has completed the assembly and checkout of experimental facilities to determine the hydrogen permeability characteristics of contemporary plastic natural gas pipes and to ascertain if there is preferential leakage of hydrogen from small leaks in a system operating with mixtures of hydrogen and natural gas. The goal of this program is to assess the impact of permeability and preferential leakage on the operation of a distribution loop when converted to service of hydrogen and mixtures of hydrogen and natural gas. Information on permeability cells was collected and reviewed. A cell utilizing aluminum construction was designed, eight cells were fabricated, and a permeability test setup was assembled and leak tested. Plastic gas distribution pipe manufacturers were contacted and samples of different types of commercially available polyethylene pipe were received from seven companies. Permeability determinations are now under way. Existing gas distribution test facilities were modified for hydrogen-natural gas leakage experiments. Four different-sized simulated leaks (capillaries and sintered discs) were incorporated into three different pressurized branches of the residential/commercial test loop, and the compressor used to develop the pressure and flow for recycle of test gases was overhauled.

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 8201, 8202, 8204, 8217

8219 **Cryohydrogen: fuel for tomorrow's commercial aircraft.** Brewer, G.D. (Lockheed-California Co., Burbank). pp 87-104 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The outlook for the use of LH_2 as a fuel in future designs of commercial transport aircraft is very favorable. The reasons are: reduction of US oil imports, more environmentally acceptable transportation, more energy efficient transportation, and lower cost transportation.

8220 **Hydrogen: potential key to tomorrow's energy utility.** Lundberg, R.M. (Commonwealth Edison Co., Chicago, IL). pp 105-110 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The various uses for hydrogen in the electric utility are discussed. The cost of electrolytic conversion is marginal, but suitable for some utilities. The costs of storage may be the major obstacle to commercial scale development. There are adequate incentives and potentially a very large market to interest all utilities in the production of hydrogen for sale. Hardware for the large-scale combustion of hydrogen requires a moderate amount of development. To break into the field at a small scale, providing hydrogen for generator cooling and ignitor fuel, provides a flexible near-term strategy.

PROPERTIES

REFER ALSO TO CITATION(S) 8862

OTHER SYNTHETIC AND NATURAL FUELS

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 8016, 8017, 8024, 8121

8221 **Platinum-catalyzed gasification of graphite by hydrogen.** Olander, D.R.; Balooch, M. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *J. Catal.;* **60**: No. 1, 41-56(30 Oct 1979).

The production of methane by reaction of molecular hydrogen with partially platinum-covered graphite was studied by the modulated molecular beam method. Although molecular hydrogen does not react with pure graphite at temperatures < 800 K, deposition of the equivalent of several monolayers of platinum on the surface results in significant gasification rates. The platinum deposits as islands several monolayers thick separated by uncovered graphite. The reaction appears to occur by dissociative adsorption of H_2 on the platinum zones followed by spill-over of H atoms to the graphite zones where methane production takes place. A detailed mechanism based on this model was applied to the molecular beam data and permitted determination of the sticking coefficient and recombination rate constant of hydrogen on the platinum zones, and the reaction rate constants and surface diffusion coefficient of hydrogen on the exposed graphite surface. 11 figures, 1 table.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 8703

8222 (CONF-790999—1) **Methane from landfills.** Zimmerman, R.E.; Wilkey, M.L. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

From 2. annual conference of applied research and practice on municipal and industrial waste; Madison, WI, USA (18 Sep 1979).

The recovery and utilization of methane generated in sanitary landfills provides the nation with an opportunity to simultaneously develop an alternative energy source and negate potential hazards. Utilization as a fuel of the combustible gas generated in sanitary landfills has been found to virtually eliminate the twin hazards of explosion and asphyxiation that have long been associated with landfill operations. Estimates place the amount of energy released from landfills in the United States in the form of combustible gases at between one and two quads per year. Using existing technology, 0.2 to 0.4 quads per year of this gas can be economically recovered. Although this is less than 1% of the nation's annual energy consumption, utilization of this alternative energy that would otherwise be lost. This paper first presents a brief description of the recovery, processing, and utilization technology currently operational in the landfill methane recovery field and then describes the current status of the US Department of Energy's (DOE) Landfill Gas Utilization Research and Development Program being developed and managed at ANL.

8223 (COO—5099-8) **Fuel gas production from animal and agricultural residues and biomass. Quarterly coordination meeting, March 15-16, 1979, Tampa, Florida. Third quarterly progress report.** Wise, D.L.; Ashare, E.; Wentworth, R.L. (Dynatech R/D Co., Cambridge, MA (USA)). 24 Apr 1979. Contract ET-78-C-02-5099. 176p. Dep. NTIS, PC A09/MF A01.

The eleventh quarterly coordination meeting of the methane production group of the Fuels From Biomass Systems Branch, US Department of Energy was held at Tampa, Florida, March 15-16, 1979. Progress reports were presented by the contractors and a site visit was made to Kaplan Industries, Bartow, Florida to see the Hamilton Standard demonstration facility for digestion of environmental feedlot residue to methane. A meeting agenda, a list of attendees, and progress reports are presented.

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 8639, 8703

8224 (DOE/EDP—0032) **Environmental development plan for biomass energy systems.** (Department of Energy, Washington, DC (USA)). Sep 1979. 56p. Dep. NTIS, PC A04/MF A01.

The initial EDP for Biomass Energy Systems (DOE/EDP-0005) was published in March 1978. This EDP provides a substantial updating of the 1978 document. It draws on analyses contained in the Environmental Readiness Document (ERD) for Fuels From Biomass. ERDs are assessments prepared independently by the Office of Environment to provide a critical review of the environmental readiness of a technology.

PROPERTIES

REFER ALSO TO CITATION(S) 8080

8225 **Testing of a 10% ethanol-90% gasoline mixture for automotive fuel.** Scheller, W.A. New York, NY; United Nations Industrial Development Organization (15 Mar 1979). 14p. (CONF-7903101—1). Department of Conference Services, Publications Div., Sales Section, Room A-3315, UN Plaza, New York, NY 10017.

From Workshop on fermentation alcohol for use as fuel and chemical feedstock in developing countries; Vienna, Austria (26 Mar 1979).

A two-million mile road test program using a mixture of 10% anhydrous ethanol and 90% unleaded gasoline as one fuel and unleaded gasoline as the control fuel was conducted from December 1974 to October 1977. About 60 vehicles participated. The results show that there are at least 4 factors which make alcohol a desirable component for blending with unleaded automotive fuel. These are increased octance number resulting from alcohol addition, positive volume change of mixing, reduced fuel consumption with gasohol fuel compared to unleaded fuel and fewer pollutants in the engine exhaust. In addition, the improved volatility of gasohol fuel provides added driver satisfaction through easier starting of the vehicle especially in cold weather.

PREPARATION

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 8283, 8635, 8721, 8722, 8723, 8724, 8925, 9312

8226 (NP—24137) **Retrospective search on the biochemical production of alcohol fuels.** (National Board for Science and Technology, Dublin (Ireland); Institute for Industrial Research and Standards, Dublin (Ireland). Technical Information Div.). Jul 1979. 233p. Dep. NTIS (US Sales Only), PC A11/MF A01.

This search covers the period 1957 to 1979. The production of alcohol from a wide variety of carbohydrate sources is covered, i.e., sugar sources, starch sources, and cellulose sources. Some general information relating to the bioconversion process and alcohol fuels are also included.

HYDRO ENERGY

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 8664

8227 (DOE/ID/01759—1) **Feasibility determination of low-head hydroelectric power development at existing sites. Final report.** Polonsky, R. (Bethlehem Mink Farm, Littleton, OH (USA)). 1979. Contract EW-78-F-07-1759. 101p. Dep. NTIS, PC A06/MF A01.

This report contains the feasibility study, economic analysis, and information relevant to reactivation of the dam in Bethelehem, NH. It outlines a plan of development which calls for sale of the power to a local utility for the first few years of the project and then predominately on-site use of the power in an innovative plan for controlled-environment agriculture. The economic analyses indicate that reactivation of the dam would be a successful venture based on the present market value of 4.5 cents/kWh. The success of the second phase in the dam's use rests on the increasing financial attractiveness of locally grown produce in a state that currently imports over 90% of its food and is experiencing the spiraling costs of food, energy, and inflation. The best-suited turbine package for the site is an Ossberger 750-kW unit which would provide 4,014,000 kWh per year with a plant factor of 61%. The total capital costs of the project are $827,935.

8228 (DOE/ID/01767—1) **Woodruff Narrows low head hydroelectric power plant feasibility determination.** (Utah Div. of Water Resources, Salt Lake City (USA); International Engineering Co., Inc., San Francisco, CA (USA); Utah State Univ., Logan (USA). Utah Water Research Lab.). Mar 1979. Contract EW-78-F-07-1767. 137p. Dep. NTIS, PC A07/MF A01.

Woodruff Narrows Reservoir, owned by the State of Utah, was built in 1961 as an irrigation reservoir. The reservoir outlet works and spillway are in need of repair, and plans have been made to enlarge the reservoir from its present capacity of 28,000 acre-feet to 53,200 acre-feet when these repairs are made. The purpose of this study was to determine if it is feasible to add hydropower facilities when the reservoir is repaired and enlarged. A computer simulation model based on mean monthly values, utilizing 26 years of recorded streamflow into the reservoir, was used to determine the mean annual energy potential for the following configurations: (1) present dam, (2) the proposed enlarged dam, (3) a new dam at the lower site with a maximum head of 65 feet, and (4) a new dam at the lower site which would store water to the same elevation as the proposed enlarged dam. Results of the simulation study show that maximum power capacities are respectively 2.1, 3.0, 3.9, and 4.5 megawatts. The marketing potential for this electric power, cost estimates and financial analysis, and environmental, social, and regulatory aspects of the proposed hydropower facilities were evaluated. The results showed the addition of hydroelectric power development at the Woodruff Narrows site would have minimal social and environmental effects on the area, would result in little or no changes in the present patterns of water and land use, income, population, and employment and would not result in any significant changes of the social structure or characteristics of the area. However, hydroelectric power development at the Woodruff Narrows site is not economically feasible at the present time. (LCL)

8229 (DOE/ID/01807—1) **Feasibility assessment, Lowell Hydroelectric Project.** (Raytheon Service Co., Burlington, MA (USA)). Apr 1979. Contract EW-78-F-07-1807. 152p. Dep. NTIS, PC A08/MF A01.

The results are presented of a feasibility analysis for hydroelectric generating facilities on the Merrimack River at Lowell,

Massachusetts. The projected facility would utilize the existing Pawtucket Dam and a portion of the existing Northern Canal. The project was examined for economic, engineering, and environmental viability, and the results are favorable. The owners intend to proceed to the next step of negotiating a firm power purchase agreement.

8230 (DOE/ID/101805—1) **Feasibility assessment for hydroelectric power development at O'Shaughnessy Dam and Griggs Dam near Columbus, Ohio.** (Burgess and Niple Ltd., Columbus, OH (USA); Columbus City Dept. of Public Service, OH (USA). Div. of Water). Nov 1979. Contract EW-78-F-07-1805. 262p. Dep. NTIS, PC A12/MF A01.

The study considered the feasibility of developing hydroelectric plants at two water supply dams, O'Shaughnessy and Griggs, both located on the Scioto River. O'Shaughnessy Dam, about 16 miles north of Columbus, Ohio, is approximately 65 feet high, impounds 16,900 acre-feet of water when full, and controls a drainage area of 980 square miles. Griggs Dam, about 9 miles downstream from O'Shaughnessy Dam, is about 35 feet high, impounding 4,200 acre-feet of water. It controls a drainage area of 1,044 square miles. Both reservoirs are primarily for water supply, and are heavily used for recreation by area residents. Hydrologic studies confirmed that discharge was in excess of water-supply needs during 85% of the time, and 20 times water supply about 20% of the time, indicating the potential for hydroelectric development of the excess flow as well as the release made to meet water supply needs.

PLANT DESIGN AND OPERATION

8231 (DOE/ID/01782—T1) **Phillips Hydroelectric Project: feasibility study. Final report.** (Development and Resources Corp., Sacramento, CA (USA)). Jun 1979. Contract EW-78-F-07-1782. 164p. Dep. NTIS, PC A08/MF A01.

This report investigates the economic, engineering, and environmental aspects of installing new hydroelectric turbine-generating units at locations immediately downstream to the existing forebay and adjacent to the existing lower powerhouse. The specific site involves the East Branch of the Croton River at the Croton Falls Executive Park site owned by Walter T. Phillips, Jr. The report appraises the condition of the existing facilities (power was generated at the site from the late 1800's to 1956), presents the redevelopment alternatives, analyzes the power and energy potential of the site, develops streams of project costs and revenues, addresses the legal and institutional aspects and develops an implementation plan for the project. The report studied six alternatives involving three manufacturers of hydroelectric turbine generating equipment and four methods of marketing the power and energy. The range of installed capacities investigated varied from 130 to 462 kW based on a net head of 20 to 40 feet. The corresponding average annual energy generation potential ranged from 785,000 to 2,096,000 kWh, and the range of available capacity for the winter months of November, December, January, February, March, and April varied from 88 to 282 kW.

ECONOMICS AND MANAGEMENT

REFER ALSO TO CITATION(S) 8227, 8408

SOLAR ENERGY

REFER ALSO TO CITATION(S) 8716, 8719, 8727, 8728

8232 (MTR—7972) **Solar Information Outreach Monitoring and Action Plan Assessment System. Final report.** Hewett, R. (Mitre Corp., McLean, VA (USA). METREK Div.). Dec 1978. Contract EG-77-C-01-4041. 71p. Dep. NTIS, PC A04/MF A01.

A design concept with functional specifications is developed for a Solar Information Outreach Monitoring and Assessment System. System logic and functions are described, and methods are recommended for performing these functions. The objective of the system is to assist the DOE Division of Conservation and Solar Applications in monitoring market development, in keeping abreast with the evolving information needs of key participants within solar markets, and the activities of other agencies that conduct related programs, and in assessing the effectiveness of DOE's solar information outreach initiatives.

8233 (SERI/TR—51-294) **Solar energy program evaluation: an introduction.** deLeon, P. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1979. Contract EG-77-C-01-4042. 112p. Dep. NTIS, PC A06/MF A01.

The Program Evaluation Methodology provides an overview of the practice and methodology of program evaluation and defines more precisely the evaluation techniques and methodologies that would be most appropriate to government organizations which are actively involved in the research, development, and commercialization of solar energy systems. Formal evaluation cannot be treated as a single methodological approach for assessing a program. There are four basic types of evaluation designs - the pre-experimental design; the quasi-experimental design based on time series; the quasi-experimental design based on comparison groups; and the true experimental design. This report is organized to first introduce the role and issues of evaluation. This is to provide a set of issues to organize the subsequent sections detailing the national solar energy programs. Then, these two themes are integrated by examining the evaluation strategies and methodologies tailored to fit the particular needs of the various individual solar energy programs. (MCW)

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 8373, 8401, 9133

8234 (DOE/ET—0110) **NOAA's role in the solar energy program; 1978 annual report to the Department of Energy.** (Department of Energy, Washington, DC (USA). Office of Energy Technology). Aug 1979. 244p. Dep. NTIS, PC A11/MF A01.

The efforts of the National Oceanic and Atmospheric Administration toward monitoring and documenting the USA solar radiation and related weather data are reported. A 1978 status report for the National Weather Service Solar Radiation Network is presented. Activities of the Solar Radiation Facility of NOAA/ERL-ARL in 1978 are reported. A workbook for approximate calibration of solar radiation sensors is included, and SOLMET user's manuals are given. Criteria for the acceptance by the NOAA National Climatic Center, Asheville, N.C., of non-NOAA data in its archives are discussed. A format to be used for transfer and processing of related solar data sets is presented. Solar radiation maps of the US for total and direct radiation on a monthly and annual basis are presented and discussed. A section on solar and climatic data applied to subdivisions of the US that are quasi-homogeneous in solar radiation heating demand and topography is included. A listing of the periods of record of all available wind observations in the National Climatic Center's meteorological archives is given. The computation of extraterrestrial solar radiation, solar elevation angle, and true solar time of sunrise and sunset is described. Also, research on the effects of aerosols and clouds on solar radiation is described. (WHK)

8235 (NESEC—6) **Status of insolation resource assessment in the northeast.** Kannenberg, S.L. (Northeast Solar Energy Center, Cambridge, MA (USA)). Dec 1979. Contract EM-78-C-01-4274. 35p. Dep. NTIS, PC A03/MF A01.

This report describes the status of insolation resource assessment at the Northeast Solar Energy Center. It summarizes activities performed here and elsewhere, services offered, and general features of solar radiation which are significant to the application of solar energy in the Northeast. (MOW)

ECONOMICS

REFER ALSO TO CITATION(S) 8342, 8401, 8717, 8718

8236 (CONF-790864—2) **Employment from solar energy: a bright but partly cloudy future.** Smeltzer, K.K.; Santini, D.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 11p. Dep. NTIS, PC A02/MF A01.

From Community renewable energy systems conference; Boulder, CO, USA (20 Aug 1979).

The current state of knowledge about employment impacts of solar versus conventional technologies is used to make quantitative and qualitative comparisons of these impacts across technologies. For purpose of quantitative comparison, employment requirements are standardized to employee effort per unit energy per year of operation. These current quantitative employment estimates show solar technology induced employment to generally be greater than for conventional technologies. The qualitative discussion focuses on the relative size and spatial distribution of the various technologies, concluding that the effects of solar are more positive than for conventional facilities because of smaller size, dispersed locations, and gradual implementation.

8237 (LA-UR—79-3390) **Residential passive solar systems: regional sensitivity to system performance costs, and alternative prices.** Kirschner, C.; Ben-David, S.; Roach, F. (Los Alamos Scientific Lab., NM (USA); New Mexico Univ., Albuquerque (USA)). 1979.

Contract W-7405-ENG-36. 32p. (CONF-791204—12). Dep. NTIS, PC A03/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

The economic potential of two passive space heating configurations are analyzed. These are a masonry thermal storage wall (Trombe) and a direct gain system - both with night insulation. A standard tract home design for each of the two passive systems is being used throughout the analysis to allow inter-regional comparisons. The economic performance of these two systems is evaluated on a regional basis (223 locations) throughout the United States. For each of the two conventional energy types considered (electricity and natural gas), sensitivity analysis is conducted to determine the impact of alternative fuel price escalation rates and solar costs upon feasibility of the two solar systems. Cost goals for solar system prices are established under one set of future fuel prices and stated economic conditions. (MOW)

8238 (SERI/RR—52-173) **Solar cost reduction through technical improvements: the concepts of learning and experience.** Krawiec, F.; Flaim, T. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1979. Contract EG-77-C-01-4042. 31p. Dep. NTIS, PC A03/MF A01.

The concepts of learning and experience are reviewed and their usefulness for predicting the future costs of solar technologies are evaluated. The literature review indicated that the cost estimates for solar energy technologies are typically made assuming a fixed production process, characterized by standard capacity factors, overhead, and labor costs. The learning curve is suggested as a generalization of the costs of potential solar energy systems. The concept of experience is too ambiguous to be useful for cost estimation. There is no logical reason to believe that costs will decline purely as a function of cumulative production, and experience curves do not allow the analyst to identify logical sources of cost reduction directly. The procedures for using learning and aggregated cost curves to estimate the costs of solar technologies are outlined. It is recommended that production histories of analogous products and processes are analyzed and the learning and cost curves for these surrogates are estimated. These curves, if judged applicable, can be used to predict the cost reductions in manufacturing solar energy technologies.

8239 (SERI/RR—8228-1) **Impact of international financial institutions on markets for solar energy systems.** Day, J.F. III; Sacks, R. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1979. Contract EG-77-C-01-4042. 213p. Dep. NTIS, PC A10/MF A01.

In support of the International Photovoltaic Program Plan prepared for DOE by SERI, Strategies Unlimited has conducted a study to assess the impact of international financial institutions on the markets for solar electric systems, especially on photovoltaic power systems. This report reviews the sources and uses of funds for economic development in the Third World. The origin of development funds since 1970 is quantified, the channels through which funds reach the developing countries are examined, and the economic sectors within the developing countries where funds are applied are detailed. This report includes a review of the World Bank, principal regional development banks, OPEC institutions, US Export-Import Bank, principal US commercial banks, and the Eurocurrency markets of the world as they finance the developing world. Both concessional and nonconcessional transfers are identified, including both official and private sources. Development bank loan practices are reviewed, including an analysis of sectors, priorities, and trends. US commercial bank international activities are reviewed including the identification of bank exposure by developing country. The report also discusses selected solar energy projects funded by the development banks. Recommendations are prepared for government policy to accelerate the widespread use of photovoltaic systems in international markets.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 8224, 8307, 8687

8240 (DSE—1020-1010-T1) **Home mortgage lending and solar energy.** Barrett, D.; Epstein, P.; Haar, C.M. (Regional and Urban Planning Implementation, Inc., Cambridge, MA (USA)). Feb 1977. Contract EX-76-A-29-1020-010. 31p. (HUD-PDR—218). Dep. NTIS, PC A03/MF A01.

The following chapters are included: (1) the importance of financing, (2) the lender's perspective on solar homes, (3) open doors, cautious lenders: the availability of mortgage credit, (4) solar retrofits: easier to finance, (5) the influence of mortgage insurers and the secondary market entities, and (6) is financing the problem. (MOW)

8241 (DSE—4281-T1) **Model document for code officials on solar heating and cooling of buildings. First draft.** (Council of American Building Officials, Washington, DC; Building Officials and Code Administrators International, Inc., Chicago, IL (USA); International Conference of Building Officials, Whittier, CA (USA); National Conference of States on Building Codes and Standards, Inc. (USA); Southern Building Code Congress International, Inc. (USA)). Mar 1979. Contract EM-78-C-01-4281. 169p. Dep. NTIS, PC A08/MF A01.

The primary purpose of this document is to promote the use and further development of solar energy through a systematic categorizing of all the attributes in a solar energy system that may impact on those requirements in the nationally recognized model codes relating to the safeguard of life or limb, health, property, and public welfare. Administrative provisions have been included to integrate this document with presently adopted codes, so as to allow incorporation into traditional building, plumbing, mechanical, and electrical codes. In those areas where model codes are not used it is recommended that the requirements, references, and standards herein be adopted to regulate all solar energy systems. (MOW)

8242 (EMD—79-84) **Solar in Federal Buildings Demonstration Program.** (General Accounting Office, Washington, DC (USA)). 10 Aug 1979. 22p. General Accounting Office, Washington, DC.

This program was proposed in the National Energy Plan as a major initiative to demonstrate the Federal Government's leadership in promoting energy conservation and the use of renewable resources in its own buildings. This report includes recommendations for DOE to (1) develop a comprehensive strategy and plan for guiding and integrating conservation and solar efforts for Federal buildings, and (2) implement a Federal buildings solar program on the scale envisioned by the National Energy Plan and the Congress. (MOW)

8243 (SERI/SP—69-071) **Technical information dissemination plan for the US Department of Energy, ETS/Solar Divisions.** Mourning, P.; Glenn, B.; Rubin, S.A.; Shoemaker, F.F.; Soto, R. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1979. Contract EG-77-C-01-4042. 74p. Dep. NTIS, PC A04/MF A01.

A plan for a technical information dissemination (TID) program for the US Department of Energy ETS/Division of Resource Management is presented. This plan's purpose is to build the most effective information transfer mechanisms possible to support the earliest appropriate commercialization of solar research and development (R & D) results in five technologies: photovoltaics, solar thermal power, biomass, ocean thermal energy conversion, and wind energy conversion. This will be accomplished by strengthening existing TID activities of DOE contractors through coordination, evaluation, and maximum use of ongoing information support services. During Year 1 of the plan, new information activities will be initiated where the leverage effect appears reasonably high in meeting the goals of the TID program. DOE in-house and contractor personnel will be involved in planning, evaluating, and implementing these technical information dissemination activities. Finally, the plan proposes to involve users of solar R & D results in external evaluation of technical information activities in each of the five solar technologies.

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 8288, 8289

8244 (AD-A—070741) **Broadened capabilities in electrostatic bonding for solar cell cover glasses. Interim technical report, January-December 1978.** Younger, P.R.; Landis, G.A.; Tobin, R.G. (Spire Corp., Bedford, MA (USA)). Mar 1979. Contract F33615-77-C-3120. 84p. NTIS PC A05/MF A01.

This report describes the first 12 months of a program aimed at furthering the development of electrostatic bonding techniques, so that integral glass covers can be attached to a variety of solar cell types, including those with multiple-layer antireflection (MLAR) coatings, the vertical junction cell, and texture etched cells. The electrostatic bonding facility is described. Tests of electron darkening of cover glasses are discussed. Detailed results of efforts to apply integral covers to various groups of MLAR coated cells are given. Variations upon the program baseline cell are to be tested to determine their compatibility with the electrostatic bonding process. Variations in contact metallization tested to date are discussed. Other variations include junction depth, dimensions (both lateral and thickness), and inclusion of back surface fields and wraparound contacts.

8245 (DOE/ET/23039—1) **Synthesis: evaluation, and defect compensation of tetrahedral glasses as possible solar cell materials. Quarterly technical progress report No. 1, February 1, 1979-April 30,**

1979. Rauh, R.D. Jun 1979. Contract AC03-79ET23039. 20p. Dep. NTIS, PC A02/MF A01.

This work describes the work performed during the first quarter of a new project to synthesize A/sup II/B/sup IV/C_2/sup V/ glasses and evaluate their potential use as solar cell materials. The results of an extensive literature search on the ternary glasses showed that those composed of Zn and Cd as the group two element, Sn, Ge, Si as the group four, and As and P as the group five element comprise the most promising materials on the basis of cost, band gap, and tendency for glass formation. The initial analysis of the defect structure expected in the ternary glasses showed that both radical and ionic defects are possible. The sparse results published in the literature indicate, however, that the former type is not important. The laboratory work was directed towards preparing bulk quantities of the ternary compounds. All the ternary arsenides have been prepared. 35 references.

8246 (DOE/JPL/1012—32) **Fracture strength of silicon solar cells. JPL Publication 79-102.** Chen, C.P. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Oct 1979. Contract EX-76-A-29-1012. 66p. Dep. NTIS, PC A04/MF A01.

In an effort to improve the reliability and lower the cost of solar cells, a test program has been developed to determine the nature and source of the flaw controlling the fracture of silicon solar cells and to provide information regarding the mechanical strength of cells. Results obtained in the first phase of a test program to develop improved methods for testing the mechanical strength of cells and to evaluate the fracture strength of typical Czochralski silicon solar cells 76 mm (3 in.) in diameter are presented. Significant changes in fracture strengths were found in seven selected in-process wafer-to-cell products from a manufacturer's production line. The fracture stength data were described by Weibull statistical analysis and can be interpreted in light of the exterior flaw distribution of the samples.

8247 (DOE/JPL/954331—7) **Silicon materials task of the low cost solar array project (Phase III). Effect of impurities and processing on silicon solar cells. Fifteenth quarterly report, April-June 1979.** Hopkins, R.H.; Davis, J.R.; Blais, P.D.; Rohatgi, A.; Campbell, R.B.; Rai-Choudhury, P.; Stapleton, R.E.; Mollenkopf, H.C.; McCormick, J.R. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Jul 1979. Contract NAS-7-100-954331. 76p. Dep. NTIS, PC A05/MF A01.

The overall objective of this program is to define the effects of impurities, various thermochemical processes, and any impurity-process interactions on the performance of terrestrial silicon solar cells. The results of the study form a basis for silicon producers, wafer manufacturers, and cell fabricators to develop appropriate cost-benefit relationships for the use of less pure, less costly Solar Grade silicon. The first reported determinations of the segregation coefficients of tungsten, tantalum, and cobalt for the Czochralski pulling of silicon single crystals were performed. Sensitive neutron activation analysis was used to determine the metal impurity content of the silicon (C/sub S/) while atomic absorption was used to measure the metal content of the residual liquid (C/sub L/) from which the doped crystals were grown. Gettering of Ti-doped silicon wafers improves cell performance by 1 to 2% (absolute) for the highest temperatures and longest times. The measured profile for Ti centers formed after an 850°C gettering operation was fitted by a mathematical expression for the out-diffusion of an impurity species. By means of cell performance data and the newly-measured segregation coefficients curves were computed to predict the variation in cell efficiency with impurity concentration for Mo, Ta, W, Nb, and Co, materials commonly employed in the construction of high temperature silicon processing equipment. Using data for second and third generation n-base ingots the cell performance curves were updated for single impurities in n-type silicon. Most impurities degrade n-base cells less than p-base devices. The effect is larges for Mo, Al, Mn, Ti, and V while Fe and Cr behave much the same in both types of solar cells. In contrast Ni and Cu both degrade n-base devices (apparently by a junction mechanism) more severely than p-base cells. (WHK)

8248 (DOE/JPL/954339—15) **Evaluation of selected chemical processes for production of low-cost silicon (Phase III). Fifteenth quarterly progress report, April 1-June 30, 1979.** Blocher, J.M. Jr.; Browning, M.F. (Battelle Columbus Labs., OH (USA)). 15 Aug 1979. Contract NAS-7-100-954339. 18p. Dep. NTIS, PC A02/MF A01.

Progress has been made during this quarter on the assembly of the Process Development Unit (PDU) consisting of four of the critical components of the 50 MT/year Experimental Process System Development Unit (EPSDU) for the production of granular semiconductor-grade silicon by the zinc vapor reduction of silicon tetrachloride in a fluidized bed of seed particles. The target operation date of October 1, 1979, still appears attainable. An experimental wetted-wall condenser, about 1/10 the size of the PDU/EPSDU design was operated to demonstrate that recirculated liquid zinc chloride can indeed be used to wash down the condensed by-product of the fluidized-bed reactor containing finely divided solid zinc and some silicon dust. The temperature distribution proved to be more critical than anticipated but the condenser now appears to be operable. Some improvement in condensation efficiency is desirable, however. Procedures were established for safe handling of $SiCl_4$ leaks and spills from the EPSDU and PDU. Preparations are being made to conduct zinc vaporization experiments in that portion of the PDU before operation of the entire PDU is initiated.

8249 (DOE/JPL/954527—10) **Investigation of test methods, material properties, and processes for solar cell encapsulants. Eleventh quarterly progress report, November 12, 1978-February 12, 1979.** (Springborn Labs., Inc., Enfield, CT (USA)). Feb 1979. Contract NAS-7-100-954527. 22p. Dep. NTIS, PC A02/MF A01.

The goal of this program is to identify, evaluate, and recommend encapsulant materials and processes for the production of cost-effective, long-life solar cell modules. During this quarter the technical activities were directed toward the reformulation of ethylene/vinyl acetate copolymer for use as a pottant compound in solar cell module fabrication. Successful formulations were devised that lowered the temperature required for cure and raised the gel content. A major volatile component was also eliminated (acrylate crosslinking agent) which should aid in the production of bubble free laminates. Adhesive strengths and primers for the bonding of ethylene/vinyl acetate to superstrate and substrate materials were assessed with encouraging results. The incorporation of silane compounds either directly into the polymer as a blend or as a surface coating gave high bond strengths (20 to 30 lbs/in.) to glass. The bonds endured 24 hours of boiling water with no delamination. Adhesion to hardboard was also excellent; however, the bonds were severely weakened by water immersion, the failure occurring within the surface of the hardboard. Some type of waterproofing treatment will be required to make hardboard products viable substrates. A survey of scrim materials was also conducted. These open hole weaves are intended for use as spacers between the cell and substrate to ensure thorough cell encapsulation, to improve insulation resistance, and to prevent migration of the pigmented pottant over the cell surface.

8250 (DOE/JPL/954777—7) **Silicon halide-alkali metal flames as a source of solar grade silicon. Seventh quarterly report.** Olson, D.B.; Gould, R.K. (Aerochem Research Labs., Inc., Princeton, NJ (USA)). Apr 1979. Contract NAS-7-100-954777. 14p. (AeroChem-TN—205). Dep. NTIS, $4.00.

This program is aimed at determining the feasibility of using high temperature reactions of alkali metals and silicon halides to produce low cost solar-grade silicon. Experiments are being performed to evaluate product separation and collection processes, measure heat release parameters for scaling purposes, and determine the effects of the reactants and/or products on materials of reactor construction. Prior work has demonstrated continuous separation of silicon from the byproduct alkali salt at a production rate of 0.5 kg h^{-1} in a graphite reactor using the reaction of Na with $SiCl_4$. Silicon of similar purity is obtained from Na + SiF_4 flames although yields are lower and product separation and collection are less thermochemically favored. During the current reporting period the results of heat release experiments have been used to design and construct a new type of thick-walled graphite reactor to produce larger quantities of silicon. A new reactor test facility has been constructed. Material compatibility tests have been performed for NA in contact with graphite and several coated graphites. All samples were rapidly degraded at T = 1200 K, while samples retained structural strength at 1700 K. Pyrolytic graphite coatings cracked and separated from substrates in all cases.

8251 (DOE/JPL/954786—6A) **Development of pulsed processes for the manufacture of solar cells.** Minnucci, J.A. (Spire Corp., Bedford, MA (USA)). Dec 1978. Contract NAS-7-100-954786. 222p. Dep. NTIS, PC A10/MF A01.

This report describes the results of a 1-year program to develop the processes required for low-energy ion implantation for the automated production of silicon solar cells. The program included (1) demonstrating state-of-the-art ion implantation equipment and designing an automated ion implanter, (2) making efforts to improve the performance of ion-implanted solar cells to 16.5 percent AM1, (3) developing a model of the pulse annealing process used in solar cell production, and (4) preparing an economic analysis of the process costs of ion implantation. During the program, phosphorus ions at an energy of 10 keV and dose of 2 x 10^{15} cm^{-2} were implanted in silicon solar cells to produce junctions, while boron ions at 25 keV and 5 x 10^{15} cm^{-2} were implanted in the cells to produce effective back surface fields. An ion implantation facility with a beam current up to 4 mA and a production throughput of 300 wafers per hour was designed and installed. A design was prepared for a 100-mA, automated implanter with a production capacity of 100 MW/sub e/ per year. A Solar Array Manufacturing Industry Costing Standards (SAMICS) economic analysis of the automated process steps of ion implantation and pulse annealing indicated that junctions can be formed and annealed at a cost of less than 3 cents per watt. The efforts during this program represent a major advance-

ment in developing the automated production of silicon solar cells with efficiencies greater than 16 percent AM1.

8252 (DOE/JPL/954817—4) **Epitaxial silicon growth for solar cells. Final report.** D'Aiello, R.V.; Robinson, P.H.; Richman, D. (RCA Labs., Princeton, NJ (USA)). Apr 1979. Contract NAS-7-100-954817. 64p. Dep. NTIS, PC A04/MF A01.

The objectives of this contract were: (1) to determine the feasibility of silicon epitaxial growth on low-cost silicon substrates for the development of silicon sheet capable of producing low-cost, high efficiency solar cells; (2) to achieve a goal of 12% (AM-0) efficient solar cells fabricated on thin epitaxial layers (<25 μm) grown on low-cost substrates; and (3) to evaluate the add-on cost for the epitaxial process and to develop low-cost epitaxial growth procedures for application in conjunction with low-cost silicon substrates. The basic epitaxial procedures and solar-cell fabrication and evaluation techniques are described, followed by a discussion of the development of baseline epitaxial solar-cell structures, grown on high-quality conventional silicon substrates. This work resulted in the definition of three basic structures which reproducibly yielded efficiencies in the range of 12 to 13.7%. These epitaxial growth procedures and baseline structures were then used to grow diagnostic layers and solar cells on four potentially low-cost silicon substrates. A description of the crystallographic properties of such layers and the performance of epitaxially grown solar cells fabricated on these materials is given. The major results were the achievement of cell efficiencies of 10.6 to 11.2% on multigrained substrates and $\sim$ 13% on a low-cost single-crystal substrate. An advanced epitaxial reactor, the Rotary Disc, is described. The results of growing sclar-cell structures of the baseline type and on low-cost substrates are given. The add-on cost for the epitaxial process is assessed. These cost estimates show a value of $\sim$ 0.46/W using existing or near-term technologies and project an add-on cost of $0.10/W for future reactors.

8253 (DOE/JPL/954868—6) **Automated array assembly, Phase II. Interim report.** D'Aiello, R.V. (RCA Labs., Princeton, NJ (USA)). Jan 1979. Contract NAS-7-100-954868. 135p. Dep. NTIS, PC A07/MF A01.

The work conducted during a 1-year program designed to establish the technological readiness and provide verification for the elements of a manufacturing sequence which would ultimately be suitable for the large-scale production of silicon solar-array modules at a cost of less than $500/peak kW is summarized. A detailed description of the development and experimental verification for individual process steps is given. The results of a detailed experimental study and evaluation of the factors which influence the performance of ion-implanted silicon solar cells are given. As a result of this study, a processing procedure was defined which can be used to produce ion-implanted solar cells with up to 15% efficiency. A review of a comprehensive test program performed on state-of-the-art commercial screen-printable metallizing inks as well as RCA-formulated materials is given. Data are presented on the critical areas of electrical conductivity, solderability, and adhesion of the films as-fired into silicon surfaces. A process for screen printing and infrared-lamp firing of silver inks for the front grid and back contact of 3-in.-diameter solar cells was developed, and performance data of these cells as a function of firing parameters and inks are given. The results of applying this process to ion-implanted solar cells are also presented. Process development and optimization studies for low-cost spray deposition of single-layer antireflection (AR) coatings are discussed. These studies included effects of spray deposition machine parameters, metallization bondability after coating, cell electrical performance as a function of AR coating type, thickness, and heat-treatment effects. The processing steps for a panel assembly process involving the lamination of a double-glass structure were developed. The procedures required to successfully laminate large panels are given. (WHK)

8254 (DOE/JPL/954868—79/2) **Automated Array Assembly, Phase II. Quarterly report No. 5, January 1-March 31, 1979.** D'Aiello, R.V. (RCA Labs., Princeton, NJ (USA)). Mar 1979. Contract NAS-7-100-954868. 49p. Dep. NTIS, $4.50.

The work reported represents a new phase of activity directed toward a cost and performance evaluation of three manufacturing sequences designed to convert silicon sheet and wafers into solar-cell array modules. The details of these sequences are described, and a near-term cost analysis for each is given. The progress made during this quarter in materials acquisition, mask design, equipment setup and qualification, process verification and refinement, and new equipment design and construction is described. Some highlights are: installation and qualification of a production model screen printer for thick-film metallization and autocoater for spray-on antireflection (AR) coating; laminations of three 4-ft-square double-glass panels; and design and construction of an automatic electrical test system. The status of the overall program plan is discussed and plans for the next quarter are outlined.

8255 (DOE/JPL/954881—6) **Automated Array Assembly, phase 2. Quarterly technical progress report, January-March 1979.** Carbajal, B.G. (Texas Instruments, Inc., Dallas (USA)). Apr 1979. Contract NAS-7-100-954881. 17p. Dep. NTIS, $4.00.

This contract provides for the fabrication of modules from large area tandem junction cells (TJC). The key activities in this contract effort are a) Large Area TJC including cell design, process verification and cell fabrication and b) Tandem Junction Module (TJM) including definition of the cell-module interfaces, substrate fabrication, interconnect fabrication and module assembly. The overall goal is to advance solar cell module process technology to meet the 1986 goal of a production capability of 500 megawatts per year at a cost of less than $500 per peak kilowatt. This contract will focus on the Tandem Junction Module process. During this quarter, effort was focused on the design of a large area, $\sim$ 36 cm^2, TJC and process verification runs. The large area TJC design was optimized for minimum I^2R power losses. In the TJM activity, the cell-module interfaces were defined, module substrates were formed and heat treated and clad metal interconnect strips were fabricated. All activities are on or ahead of schedule.

8256 (DOE/JPL/954882—18) **Process development for automated solar cell and module production. Task 4: automated array assembly. Quarterly report No. 3.** Philp, T.B.; Hagerty, J.J. (MB Associates, San Ramon, CA (USA)). 13 Jul 1979. Contract NAS-7-100-954882. 21p. Dep. NTIS, PC A02/MF A01.

The objective of this program is to develop process and handling technology required to allow large volume, low cost terrestrial solar array production. Emphasis has been placed on module lay-up and interconnect and edge sealing. During this reporting period, progress has been directed toward automated interconnection and lay-up of solar modules using a Unimate model 2000B industrial robot. A study of interconnect bond methods lead to the decision that induction heating would be most applicable to robot operation. The design approach for the interconnect and lay-up station involves a cell preparation sub-station that will unload the cells from cassettes, orient them optically and position an interconnect for bonding to the cell. At that point, the robot arm with a bonding head, will solder the lead, then place the cell into the array configuration, and solder it to the adjacent cell. The robot has been programmed to pick and place 3 inch diameter cells into a 12" x 16" array with an average time of 6 seconds per cell. This can be reduced by optimizing the program and a target rate of 6 to 12 seconds per cell was set for placement and interconnection. Edge sealant compatibility studies continue. Hot melt techniques have been demonstrated by adhering the edge frame to several 1' x 4' modules using an off-the-shelf hand held hot melt gun.

8257 (DOE/JPL/954888—6) **Silicon sheet growth development of the large area silicon sheet task of the Low Cost Silicon Solar Array Project. Sixth quarterly progress report, January 1-March 31, 1979.** Lane, R.L.; Merz, F. (Kayex Corp., Rochester, NY (USA)). 1979. Contract NAS-7-100-954888. 23p. Dep. NTIS, $4.00.

During this reporting period, a successful 100 kilogram run was performed. Six ingots of 13 cm diameter were grown, ranging in size from 15.5 kg to 17.7 kg. Melt replenishment methods included both poly rod and lump feed material. Samples from each ingot were prepared for solar cell fabrication and analyses, impurity analysis, and structural studies. The furnace was converted to the 14-inch hot zone and preliminary heat runs were performed. Two successful runs were demonstrated, by growing 25 kg ingots from 30 kg melts. Also, a 100 kg run was attempted, utilizing the 14-inch crucible hot zone, but was prematurely terminated due to excessive monoxide which accumulated on the viewports and a seed failure.

8258 (DOE/JPL/954929—5) **Investigation of reliability attributes and accelerated stress factors on terrestrial solar cells. Fifth quarterly report, 9 March 1979-1 July 1979.** Lathrop, J.W.; Prince, J.L. (Clemson Univ., SC (USA)). 15 Jul 1979. Contract NAS-7-100-954929. 56p. Dep. NTIS, PC A04/MF A01.

Results obtained include the definition of a simplified stress test schedule for terrestrial solar cells based on the work performed during the first program year, and the design and fabrication of improved jigs and fixtures for electrical measurement and stress testing. Implementation of these advanced techniques for accelerated stress testing is underway on three solar cell types different from the cell types investigated in the first year's program. In addition, review of the literature on second quadrant phenomena was begun and some preliminary second-quadrant electrical measurements were performed. Results obtained at the first down time for 75°C B-T testing and biased and unbiased T-H pressure cooker testing of type F cells showed little or no degradation in electrical parameters. Significant physical effects (large solder bubbles) were noted for type F cells subjected to the pressure cooker stress test.

8259 (DOE/JPL/954995—5) **Develop silicone encapsulation systems for terrestrial silicon solar arrays. Fifth quarterly progress report, April 1-June 30, 1979.** (Dow Corning Corp., Midland, MI

(USA)). Jul 1979. Contract NAS-7-100-954995. 31p. Dep. NTIS, PC A03/MF A01.

This study is directed toward the development of a cost effective encapsulation system for photovoltaic modules using silicone based materials. Progress is reported under the headings (1) Weather-Ometer stressing vs weathering history of silicone and silicone modified materials, (2) thermal cycling stress test results, (3) dirt pickup and retention measured by outdoor exposure, (4) silicone-acrylic copolymers as encapsulants, and (5) cover films containing uv absorbers. (WHK)

8260 (DOE/JPL/955055—1-T1) **Silicon solar cell process development, fabricaton, and analysis. Second quarterly report, January thru March, 1979.** Minahan, J.A. (Spectrolab, Inc., Sylmar, CA (USA)). 1979. Contract NAS-7-100-955055. 53p. Dep. NTIS, $5.25.

Solar cells have been constructed from polycrystalline silicon sheet material (10 cm x 10 cm Wacker Silso). These cells have been made using conventional aerospace methods and serve as the so-called baseline cell for analysis and comparison with cells to be made from similar material, but using optimized processing techniques. Before and during the processing of the Wacker baseline cells in a cleaned diffusion tube, control cells were built using the baseline method. All cells were measured on the Spectrolab Mark III Solar Simulator at air mass zero and 28°C. Average efficiency for the Wacker Silso baseline cells, using the total device area, was 9.5%. Efficiency was found to vary with location in the sheet. Center regions had higher efficiencies, 9.9% average, whereas corner and edge regions had lower efficiencies, 8.9% average. In general, the efficiency falls off with distance from the center of the sheet. This could possibly be a result of radial grain growth at the edges and grain growth along the axial direction in the core region of the casting. Control cells made from aerospace grade silicon using the baseline process had average efficiency of 11.7%. Like the polycrystalline cells, the control cells had antireflection coatings of tantalum pentoxide.

8261 (DOE/JPL/955164—3) **Development of economical improved thick film solar cell contact. Final report, September 1978-April 1979.** Ross, B. (Ross (Bernd) Associates, San Diego, CA (USA)). Apr 1979. Contract NAS-7-100-955164. 72p. Dep. NTIS, $5.25.

The potential for economy and efficiency has been demonstrated for the thick film metallization process using screen printing for solar cell electrodes. However, process reliability and materials economy remain deficient. It is believed that these deficiencies can be removed by the use of ink formulations designed specifically for silicon solar cells, departing from ceramic technology tradition and utilizing all metal systems. The objectives of this investigation are as follows: 1) eliminate the glass frit which has been the conventional liquid phase sintering medium and adhesive for metallization inks; 2) provide an appropriate metal which can serve as the liquid phase sintering medium; 3) find a chemical constituent which effectively removes the native oxide from the silicon during the firing step, which can be made part of the ink, and which either becomes fugitive or remains an inert part of the matured metallization; and 4) maintain cognizance of the cost objectives of the LSA Project in selecting materials and processes. Progress is reported. (WHK)

8262 (DOE/JPL/955201—2) **Low cost solar array project: composition measurements by analytical photon catalysis. Second quarterly report, 1 January 1979-31 March 1979.** Sutton, D.G.; Galvan, L.; Melzer, J.; Heidner, R.F. III. (Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.). 1979. Contract NAS-7-100-955201. 16p. Dep. NTIS, $4.00.

The object of this research is to assess the applicability of the photon catalysis technique for effecting composition analysis of silicon samples. In particular, our technique is to be evaluated as a detector for the impurities Al, Cr, Fe, Mn, Ti, V, Mo, and Zr. During the first reporting period Al, Cr, Fe, and Mn were detected with the photon catalysis method. The best fluorescence lines to monitor were established and initial sensitivities to each of these elements by atomic absorption calibration were determined. In the course of these tests vapor pressure curves for these four pure substances were also mapped. During the second quarter Ti and Si were detected with the technique. The best lines to monitor were cataloged and vapor pressure curves were determined. Attempts to detect vanadium were unsuccessful due to the refractory nature of this element and the limited temperature range of the evaporator.

8263 (DOE/JPL/955270—1) **Low cost Czochralski crystal growing technology: near term implementation of flat plate photovoltaic cost reduction of the low cost solar array project. First quarterly progress report, March 1-June 30, 1979.** Roberts, E.G. (Kayex Corp., Rochester, NY (USA)). 1979. Contract NAS7-100-955270. 13p. Dep. NTIS, PC A02/MF A01.

During the quarterly reporting period, an overall conceptual design package was submitted to JPL. The order for the R.F. heating generator has been authorized by JPL and the order placed. Delivery of the contractor-owned CG 2000 crystal growing furnace is scheduled for the end of July. The microprocessor has been purchased and work is currently ongoing to develop operating programs and software. Orders for necessary piece parts are currently being placed.

8264 (DOE/JPL/955318—2) **New method of metallization for silicon solar cells. Second quarterly report, April 1-June 30, 1979.** Macha, M. (SOL/LOS, Inc., Los Angeles, CA (USA)). 1979. Contract NAS-7-100-955318. 25p. Dep. NTIS, PC A02/MF A01.

The second quarter of this program is concerned with the determination of the firing cycle in a horizontal tube furnace for MoO_3:Sn ink composition applied by silk screening process on P on N structured solar cells. In comparison with the strip heater used in the first quarter to determine the reaction mechanism, the reduction of MoO_3 in the tube furnace progresses at a much faster rate and the Sn:Mo alloy forms at a much lower temperature. The device characteristics determined by the V-I curve showed a high resistance (approx. 10 Ohms) at peak temperatures between 600°C and 800°C. The high series resistance can be attributed to the lack of formation of $MoSi_2$ within the used temperature range as pointed out in references to theoretical and experimental work concerned with the formation of metal silicides. According to these references this temperature range is right for the formation of silicide of titanium, which, besides having a lower resistance value, forms in the presence of an oxidized silicon surface. Therefore the basic MoO_3 ink composition was modified by an addition of titanium resinate corresponding to a titanium concentration of 1-15000 based on the solids in the mixture. The addition of titanium decreased the series resistance to the level of 1 Ohm or better and the device characteristics were comparable with the devices metallized by electroless nickel and silk screened silver.

8265 (DOE/JPL/955328—2) **Establishment of a production-ready manufacturing process utilizing thin silicon substrates for solar cells. Quarterly technical report No. 2, 1 April 1979-31 June 1979, Motorola report No. 2364/2.** Pryor, R.A. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1979. Contract NAS-7-100-955328. 32p. Dep. NTIS, PC A03/MF A01.

A comparison has been accomplished between several wafer thicknesses and surface conditions. A simple diffused junction structure was used. This structure consists of a phosphine diffused front junction on a p-type substrate with no back surface enhancement. Junction edges were prepared by a mesa etch technique. LPCVD silicon nitride was used for an AR coating and plating mask. The cell back was fully covered with metal. A plated palladium-silver metallization was used for all the test devices in order to eliminate possible dip-soldering difficulties with the thinnest substrates. All test lots but one used substrates which were texture-etched at the start of the process. The substrate types used are classified as follows: (a) polished, 14 mil, 2 Ω-cm; (b) as-sawed, 17 mil, 1 Ω-cm; (c) as-sawed, 8 mil, 1 Ω-cm; (d) chem-etched, 7 mil, 1 Ω-cm; (e) chem-etched, 4 mil, 1 Ω-cm. Statistical data have been accumulated at each step before, during, and after processing. Substrate thickness, substrate resistivity, textured surface peak height, and phosphorus diffusion sheet resistance were measured. Tests were made for open circuit voltage and photo-generation current before AR coat deposition, after AR coat patterning, and after metallization. Current-voltage curves were taken for representative samples. In general, the electrical performance was found to depend on substrate thickness in exactly the manner predicted by theory. For the simple, non-BSF structure, power conversion efficiency decreases as the substrate is made thinner.

8266 (DOE/JPL/955339—2) **Anti-reflection coatings on large area glass sheets. Quarterly technical report No. 2, 1 April 1979-30 June 1979, Motorola report No. 2366/2.** Pastirik, E. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1979. Contract NAS-7-100-955339. 11p. Dep. NTIS, PC A02/MF A01.

The ultimate goal of this project is improvement of the efficiency of photovoltaic modules through increased transmission of light by the module cover. One method of increasing transmission is by reducing the reflection of light by the module cover, a reflection which accounts for a 4% loss of transmission for each coverglass-air interface. This is the second quarterly report of a one-year program designed to research and perfect a method of producing antireflective coatings on large glass sheets through the use of sodium silicate hardened by exposure to acid. At present, the linear motion device required for the contract is nearing completion; the required motor will arrive within ten days. Experiments performed have revealed sources of potential difficulty which will be addressed during the next quarter. Task 1, design and construction of the linear drive, has overrun its scheduled completion time by a few days, but presents little inconvenience in terms of progress on the rest of the program and will be completed shortly. Tasks 2 and 3, sodium silicate solution preparation and physical property determination, have been completed on schedule. (WHK)

8267 (DOE/JPL/955342—1) **Development of Megasonic cleaning for silicon wafers. Quarterly report No. 1.** Mayer, A. (RCA Solid

State Div., Somerville, NJ (USA); RCA Labs., Princeton, NJ (USA)). 1 Jul 1979. Contract NAS-7-100-955342. 24p. Dep. NTIS, $4.00.

The purpose of the program is to scale up, automate, and improve the existing RCA-invented Megasonic Cleaning System to increase its throughput from about 600 wafers per hour to about 2500 wafers per hour, in preparation for the large-scale production of flat-plate silicon solar-cell arrays. Design of the dynamic version of the Megasonic station was completed, and the unit was built, by the Fluorocarbon Company. It was delivered and is in the process of being installed. Plans are underway to maximize utilization of the cleaning solution - a mixture of water, ammonium hydroxide, and hydrogen peroxide - by recirculation and filtration. A circulation system was designed, corrosion tests were carried out, and most of the parts have been delivered. Tests showed that polysulfone might be a useful material of construction. The filter membrane and wafer carriers will be fabricated from this. An air-drying module capable of delivering air filtered through a HEPA (high-efficiency particulate air) filter at a speed of about 28.5 m/s was designed and delivered; the unimpeded flow was measured to be 25 +- 2.5 m/s. Quartz wafer carriers were designed to fit diffusion tubes with 101-mm ID, one with 3/16-in. and another with 3/32-in. spacing. These have been ordered. A design for a plastic carrier, polysulfone or polytetrafluoroethylene (PTFE), was also worked out for use during the production rate, full-scale test of the Megasonic cleaning system.

8268 (DOE/JPL/955382—1) **Low-Cost Solar Array Project. Task I. Silicon material: investigation of the hydrogenation of $SiCl_4$. Quarterly report.** Mui, J.Y.P.; Seyferth, D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 12 Jul 1979. Contract NAS-7-100-955382. 22p. Dep. NTIS, PC A02/MF A01.

A program was initiated in April of this year to study the hydrogenation of silicon tetrachloride to trichlorosilane, 3 $SiCl_4$ + 2 H_2 + Si reversible 4 $SiHCl_3$. This contract is conducted as a complementary research and development program to supplement the engineering process development activities for the process-unit under Union Carbide Contract No. 954 334. Two parallel efforts are included in the submitted program plan. One is a process study to collect reaction kinetic data on the rate of the hydrogenation reaction as a function of various reaction parameters. The other is a basic research effort to study the reaction mechanism and to develop new catalysts to improve the reaction rate and the conversion of $SiCl_4$ to $SiHCl_3$. A laboratory stainless steel reactor is designed to operate at pressures up to 500 psig and reactor temperatures up to 600°C. Construction o the hydrogenation apparatus has progressed according to the program plan. An in-line gas chromatograph is built onto the reactor assembly to provide accurate, instantaneous analysis of the reaction product mixture. The hydrogenation apparatus is also semi-automated so that it can be run continuously. This design feature is especially useful for prolonged reactions to study the life of the Si mass bed. Start-up of the hydrogenation reactor is schedules for the month of August.

8269 **Solar array fabrication method and apparatus utilizing induction heating.** Luft, W.; Kennedy, R.E.; Mesch, H.G. (to TRW Inc.). US Patent 4,154,998. 15 May 1979. Filed date 12 Jul 1977. 8p.

A solar array is described having solar cells mounted on a substrate and electrically joined by rear connector elements on the substrate and front connector elements secured between the cells to the substrate is fabricated by placing the array components in assembled relation and utilizing induction heating to heat to their fusion temperatures a thermoplastic adhesive layer on the substrate and contacting fusible cladding on the solar cells and the connector elements while retaining the components in firm contact to effect adhesive bonding of the solar cells and front connector elements to the substrate and metallic bonding of the solar cells and connector elements to one another.

8270 (JPL—5101-67) **Proceedings: 9th Project Integration Meeting. Low Cost Solar Array Project.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1978. Contract EX-76-A-29-1022. 494p. (CONF-7804161—). Dep. NTIS, PC A21/MF A01.

From 9. LSA project integration meeting; Pasadena, CA, USA (11 Apr 1978).

Invitation-controlled attendance at the meeting included Project participants from JPL and LSA Project contractors, together with representatives of the DOE Division of Solar Technology and other agencies participating in the Photovoltaic Program. The status of the JPL Low-Cost Solar Array Project is described in detail. The report includes the following sections: (1) project analysis and integration, (2) technology development area (silicon material task, large area silicon sheet task, and encapsulation task), (3) production process and equipment area, (4) engineering area, and (5) operations area. (WHK)

8271 (SAN—1459-4) **Cadmium sulfide/copper sulfide heterojunction cell research. Technical progress report No. 4, June 1, 1978-August 31, 1978.** (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.). 28 Sep 1978. Contract EG-77-C-03-1459. 45p. (LMSC-D—630309). Dep. NTIS, PC A03/MF A01.

The multi-cathode deposition system has been brought into operation and used to deposit multilayer films of Cu/sub x/S/CdS/In/Al in a single pumpdown. In addition, it has been used to prepare In doped CdS films by co-sputtering of Cd and In. Analysis of the photovoltaic devices deposited in the system to date have determined the areas requiring further development. These are the CdS/substrate contact and the doping distribution through the CdS film. The initial photovoltaic cells have been characterized by a built-in retarding field. Electrical, optical, and structural measurements on all components of the multilayer films have been carried out and related to the corresponding deposition parameters. The theory of reactive sputter deposition of compound semiconductors has been developed to explain the rate limiting deposition processes and the ease with which a stoichiometric compound is formed.

8272 (SAN—1876-2) **Thin-film polycrystalline silicon solar cells. Quarterly report No. 2, December 11, 1978-March 10, 1979.** Faughnan, B.W.; Blanc, J.; Redfield, D. (RCA Labs., Princeton, NJ (USA)). May 1979. Contract ET-78-C-03-1876. 42p. Dep. NTIS, PC A03/MF A01.

In the second quarter, 40 solar cells were fabricated on Wacker substrates. One series of cells was used to compare the effect on AM-1 parameters of making the cells from the center region or the edge region of the original 10 x 10-cm wafer. Another series tested the effect of varying the junction diffusion temperatue from 850 to 900°C. In both cases the differences were not large, except for diffused junctions at 850°C. Passivation of grain boundaries by heating in a plasma discharge containing atomic hydrogen was attempted on a number of cells. With one ion-implanted cell, which was poor to begin with, a 21% improvement in efficiency was obtained. However, on a number of other more efficient cells, there was no significant improvement. A variety of experimental techniques for studying polycrystalline silicon and the effects of grain boundaries were implemented this quarter. They include measurement of minority carrier lifetime, QE curves with and without bias light, QE measurements using a 150-μm spot, within a grain and including a grain boundary, laser scans across grain boundaries, and deep-level spectroscopy by transient capacitance. These measurements allowed us to assess the effects of grain boundaries on solar-cell performance. The surface topography of etched and polished cells was studied by SEM. An SEM method of determining the crystallographic orientation of small grains, called electron channeling patterns (ECP), was developed.The phosphorus diffusion profiles in Wacker material inside a grain and including a grain boundary were measured by SIMS. The presence of small black inclusions in Wacker material was observed.

8273 (SAN—2208-T2) **Vacuum deposited polycrystalline silicon films for solar cell applications. Quarterly technical progress report No. 2, January 1-March 31, 1979.** Feldman, C. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 30 Apr 1979. Contract ET-78-A-03-2208. 45p. Dep. NTIS, PC A03/MF A01.

Research is being conducted on grain growth phenomena and interactions pertaining to an all-vacuum deposition technique for fabricating thin-film polycrystalline silicon solar cells. Investigations dealt primarily with the structure silicon/TiB_2/alumina substrate, which seems thus far to be the most satisfactory from the standpoint of stability and potential applicability to low-cost solar cells. Secondary ion mass spectrometry was used to study the various interfaces of the device structure and revealed important information on possible sources of impurities and instabilities. Investigation of the B/Ti couple on alumina indicated that a stoichiometric TiB_2 back electrode could easily be formed and that excess boron could be removed, probably through reaction with water vapor. Unusually large unoriented grains (~ 30 μm) were grown under certain conditions that are described, but not yet fully understood.

8274 (SAN—2219-1) **Amorpuous thin films for solar-cell applications. Quarterly report No. 1, September 11-December 11, 1978.** Carlson, D.E.; Balberg, I.; Crandall, R.S.; Goldstein, B.; Hanak, J.J.; Pankove, J.I.; Staebler, D.L.; Williams, R. (RCA Labs., Princeton, NJ (USA)). Jan 1979. Contract ET-78-C-03-2219. 72p. Dep. NTIS, PC A04/MF A01.

This report describes the work performed at RCA Laboratories on the five research tasks of the present contract. The section on theoretical modeling deals with the Meyer-Neldel rule and the thermal generation of Frenkel defects in a-Si:H. In Section III, Deposition and Doping Studies, we describe our deposition systems and doping studies involving fluorine, carbon, and nitrogen. The next section involves experimental methods for characterizing a-Si:H, and we discuss recent transport measurements in p-type a-Si:H, conductivity measurements as a function of dehydrogenation, tunneling in a-Si:H, surface studies of Pt deposition, and Schottky barriers between electrolytes and a-Si:H (values of V/sub oc/ as high as 1.5 V have been obtained with these barriers). In Section V, Formation of Solar-Cell Structures, we present optimization data for front and back cermet contacts, and we show experimental data for an MIPS

structure (MIS cell with a thin p+ layer) as well as for a graded p-i-n cell. Section VI involves the theoretical and experimental evaluation of solar-cell parameters. Laser scanning has been used to investigate the damage created by electron-beam evaporation and to determine the various contributions to the series resistance. Collection efficiency measurements have been performed as a function of bias and indicate that an internal field is necessary for efficient collection. We also discuss the junction characteristics of Pt diodes in terms of a Mott barrier.Finally, we present results on the degradation of a-Si:H cells during fabrication and upon exposure to humidity.

8275 (SAND—79-1406C) **SOLCEL II: an improved photovoltaic system analysis computer program.** Hoover, E.R. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 4p. (CONF-800106—2). Dep. NTIS, PC A02/MF A01.

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The photovoltaic system analysis computer program, SOLCEL, developed at Sandia Laboratories has been used extensively by a number of government agencies and private contractors. Over the past year the program has been modified extensively. The latest version is called SOLCEL-II and is now available for use by the PV community. It is much more flexible than its predecessor and most of the individual components are modeled in greater detail. In addition to simulating the annual performance of a particular photovoltaic system, the new version has the capability to optimize design parameters or perform sensitivity studies in a single computer run.

8276 (SERI/TR—8251-1) **Characterization and assessment of potential European and Japanese competition in photovoltaics. Final report.** (Science Applications, Inc., McLean, VA (USA)). Oct 1979. Contract EG-77-C-01-4042. 130p. Dep. NTIS, PC A07/MF A01.

This study is an assessment of the potential of European and Japanese firms to produce and market photovoltaic (PV) power systems internationally in competition with firms in the United States. It consists of three distinct parts: (1) an overview of worldwide export activity which describes the general posture of selected European countries and Japan; (2) an assessment of European competition focusing on Germany, France, and the United Kingdom; and (3) an assessment of Japanese competition. All research was conducted within the United States relying on published reports in the scientific, trade, and business press; a firm's annual reports; and telephone interviews with representatives of European and Japanese firms. European and Japanese government representatives were also contacted and government-sponsored programs evaluated. European competition is addressed in three areas: characterization of the PV industry; current and potential marketing activity; and the status of PV and related technological developments. The same areas are addressed for depicting Japanese competition except that greater emphasis is placed on past industrial experience and related semiconductor sales.

8277 **Method of construction of a multi-cell solar array.** Routh, D.E.; Hollis, B.R. Feltner, W.R. (to National Aeronautics and Space Administration). US Patent 4,156,309. 29 May 1979. Filed date 23 Dec 1977. 4p.

The method of constructing a high voltage, low power, multi-cell solar array is described wherein a solar cell base region is formed in a substrate such as but not limited to that of silicon or on a substrate of sapphire, and then by the steps of application of a protective coating on the base, patterned etching of the coating and base to thereby form discrete base regions, forming a semi-conductive junction and upper active region in each base region defined by photolithography, and thus forming discrete cells which are interconnected by metallic electrodes.

8278 **High-purity silicon for solar cell applications.** Dosaj, V.D. (Dow Corning Corp., Midland, MI); Hunt, L.P.; Schei, A. *J. Met.;* **30**: No. 6, 8-13(Jun 1978).

Demonstration quantities of high-purity silicon were produced using high-purity quartz and chemically purified charcoal in a modified 50-kVA arc furnace. Impurities from carbon reducing materials were found to be the major source of contamination. Charcoal used for smelting can be purified to very low impurity levels by halogen treatment at temperatures above 2000°C. However, the low silicon recovery with purified charcoal appears to be related to the low rate of the silicon-producing reaction between silicon carbide and silica in the high-temperature zone of the furnace. X-ray examination of the charcoal showed a clear structural change during high-temperature purification and this change may be used as a test for the suitability of a purification method in future work. Investigation is underway to define purer, low-cost, reactive reducing materials in order to meet the $10/kg solar-grade silicon cost in tonnage quantities. The arc-furnace process is considered to be a feasible process to meet this goal.

8279 **Photovoltaic concentrating array.** Donovan, R.L.; Broadbent, S. (Martin Marietta Corp, Denver, Colo). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1593-1599(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A Phototoltaic Concentrating Array (PCA) for terrestrial application is described. The PCA uses point focusing acrylic Fresnel lenses to concentrate sunlight on high intensity solar cells. The objective of the PCA development was to obtain economical photovoltaic power generation by replacing relatively high priced solar cells with lower cost lenses. The PCA operates at a concentration of 40, tracks the sun in two axes, and is passively cooled. An inherent advantage of concentrating systems over flat arrays is that they can afford high cost, high performance cells since the cost impact of the cells becomes secondary to total system cost.

8280 **Ultra-thin silicon solar cells for high performance panel applications.** Gay, C.F. (Spectrolab, Inc, Sylmar, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 2121-2124(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Solar cells have been fabricated which achieved the highest power to mass ratios and radiation stability yet reported for silicon devices. The thinnest cells (.04 mm) had initial efficiencies in excess of 2 watts per gram (AMO) and 1.7 watts per gram after an irradiation of 1×10^{15} equivalent 1 MeV electrons per square centimeter. The cells have been successfully interconnected by welding and filtered. Handling losses during cell manufacture and panel assembly may be minimized through the use of an integral reinforcing perimeter or ribs which remove almost all restrictions on cell thickness and area. Such a cell is typically composed of a mainsection which can be as thin as 0.015 mm and is supported at the edge by a thicker border of silicon.

THERMIONIC AND THERMOELECTRIC CONVERSION

REFER ALSO TO CITATION(S) 8758

8281 **Application of solar thermoelectric generators in near-sun missions.** Raag, V.; Hankins, L.; Swerdling, M.; Ivanoff, R. (Syncal Corp, Sunnyvale, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1699-1706(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Future planetary near-sun missions, such as those studied for low-altitude Mercury Orbiters, introduce challenges in the selection of appropriate power sources. Study results have shown that conventional silicon solar array technology is not adequate to produce power because of expected temperatures which range from -90°C to +285°C in about 40 to 50 minutes for 16 sun eclipses/day. The Solar Thermoelectric Generator (STG), which requires relatively high temperatures, is being considered as a replacement power source. The complete STG consists of a solar concentrator and multiple thermopiles, each containing numerous thermocouples and thermal insulation material.

8282 **Solar furnace type high power density thermoelectric generator.** Brandstetter, A.; Yekutieli, G.; Lanxner, M.; Shai, I. (Weizmann Inst of Sci, Rehovot, Isr). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 1989-1995(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The performance of a solar-powered thermoelectric generator based on an earlier described high-power density thermopile concept is reported. In this generator the wedge-shaped electrodes bridging between the thin p and n-type thermoelements are arranged in a cylindrical configuration forming a central cavity in which solar radiation is trapped like in a solar furnace. The device has a nominal electrical output of 10-watt at 5 percent thermal efficiency and has so far been tested with solar radiation from a Fresnel lens, on an automatic sun-tracker, supplying about 100-watt thermal input. Results of thermoelectric characteristics and performance measurements are presented, with particular emphasis on contact resistance effects and stability. Very good agreement is found with predicted performance in relation to the triangular electrode thermopile concept.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 8222, 8223, 8224, 8226, 8444, 8635, 8654, 8713, 8721, 8722, 8723, 8724, 8725, 8726, 8925, 9312

8283 **Bioconversion of cellulosic substances into energy chemicals and microbial protein.** Ghose, T.K. (ed.). New Delhi, India; Indian Institute of Technology (1978). 609p. (CONF-770222—).

From Symposium on bioconversion of cellulosic substances into energy, chemicals and protein; New Delhi, India (Feb 1977).

The presentations at an international symposium on bioconversion of cellulose into energy chemicals and single cell protein are compiled in this journal. The keynote addresses are included. Topics covered at the symposium were: (1) cellulolytic organism characteristic and substrates; (2) cellulose enzymes - fractionation and identification; (3) cellulase biosynthesis; (4) saccharification; (5) direct fermentation of cellulosic substances; and (6) fermentation and bioconversion of cellulose. Each article is abstracted and indexed separately.

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

REFER ALSO TO CITATION(S) 8208

8284 (COO—4271-6) **Sensitized photoelectrolysis of water with sunlight. Final report, June 1, 1977-December 31, 1978.** Ghosh, A.K.; Maruska, H.P. (Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Lab.). Dec 1978. Contract EG-77-C-02-4271. 169p. Dep. NTIS, PC A08/MF A01.

A study was made of solar driven water photoelectrolysis cells employing semiconductor electrodes. An extensive review of the literature was undertaken, and the three major problem areas for these devices were identified: corrosion, poor sunlight absorption, and external bias requirement. Although many semiconductors had been tested, none had proven free of all three defects. Two approaches were thus followed for the experimental studies: impurity sensitization of wide band gap stable oxides, and heterostructure formation between unstable sunlight absorbers and corrosion resistant oxides. Water decomposition was achieved with visible light excitation of Cr-doped TiO_2. Transport properties were studies for TiO_2 and $SrTiO_3$ electrodes doped with V, Cr, Mn, Fe, Co, and Ni. The correlation between bias requirement and electron affinity of oxides was identified. Performance of heterostructure electrodes was shown to be limited either by pin hole problems or by potential barriers between the valence bands.

8285 **Chemically derivatized n-type semiconducting gallium arsenide photoelectrodes. Thermodynamically uphill oxidation of surface-attached ferrocene centers.** Bolts, J.M.; Wrighton, M.S. (Massachusetts Inst. of Technology, Cambridge). *J. Am. Chem. Soc.;* **101**: No. 21, 6179-6189(10 Oct 1979).

n-type semiconducting GaAs surfaces can be derivatized using (1,1'-ferrocenediyl)dichlorosilane (1), resulting in surface-attached, electroactive, ferrocene centers. Coverage of electroactive material significantly exceeds monolayer coverage in most experiments. The surface-attached ferrocene material can be oxidized in an uphill sense by irradiating the surface with light of energy greater than 1.4 eV, the band gap of GaAs. Ferrocene can be photooxidized to 50% conversion at a poential of ~ -0.25 V vs. SCE, whereas the 50% conversion occurs at a potential of +0.40 V at a reversible electrode. The ferrocene, then, can be driven uphill by greater than 0.6 V. Surface-attached, photogenerated ferricenium can in turn oxidize solution reductants such as ferrocene itself, I^-, or N,N,N',N'-tetramethyl-p-phenylenediamine as determined by cyclic voltammetry in CH_3CN/0.1 M [n-Bu_4N]ClO_4 solutions. Derivatized electrodes are fairly rugged and result in modestly improved optical to electrical energy conversion compared to a naked GaAs photoelectrode-based cell employing a CH_3CN/0.1 M [n-Bu_4N]ClO_4 solution of ferrocene and ferricenium. 5 figures, 1 table.

8286 **Nonbiological photochemical energy conversion: can it compete.** Harrigan, R.W. (Sandia Labs., Albuquerque, NM). *J. Solid State Chem.;* **22**: No. 1, 9-15(Sep 1977).

Solar photochemical energy conversion has much in common with solar thermal energy conversion systems. As a result, it is not to be expected that photochemical systems will be much less expensive than solar thermal systems. Since direct fuel production is unique to the photochemical system, the most promising application areas are in those sectors such as transportation that have particular needs for fuels. The results of an analysis of a combined photovoltaic/thermal system applied to meeting a community energy demand is reported.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 8275, 8585, 8592, 8593, 8594

8287 (COO—4094-50) **Residential experiments.** Kern, E.C. Jr. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract EY-76-C-02-4094. 14p. (CONF-790991—2). Dep. NTIS, PC A02/MF A01.

From Photovoltaic advanced R and D annual review meeting; Denver, CO, USA (17 Sep 1979).

Residential photovoltaic (PV) systems development activities planned by US DOE are discussed. The residential PV energy impacts, DOE Residential Project, Residential Experiment Stations, and System Readiness Experiments are described. (MHR)

8288 (DOE/JPL/1012—35) **Interim implementation structure for development of performance criteria and test standards for photovoltaic systems.** (Jet Propulsion Lab., Pasadena, CA (USA); Solar Energy Research Inst., Golden, CO (USA)). 15 Nov 1979. Contract EX-76-A-29-1012;EG-77-C-01-4042. 35p. Dep. NTIS, PC A03/MF A01.

This document presents an implementation structure for the near-term development of performance criteria and test methods for photovoltaic (PV) materials, components, subsystems, and systems. The approach is designed to be responsive to the Photovoltaic Research, Development and Demonstration Act of 1978 (PL-95-590). The project is organized into four tasks: (1) establishment of performance criteria and the development of test methods; (2) development of laboratory accreditation/product certification guidelines; (3) development of validation methodologies; and (4) coordination of the quality assurance effort with consensus standards and code organizations. A schedule and milestones are presented for each task. The appendices provide a brief overview of standards and the standards development process. The philosophy behind this project is to develop industry- and user-established performance criteria, test methods, and accreditation procedures which may then be referred to independent consensus standards organizations for the preparation of consensus standards. The emphasis in execution of this approach will be to develop uniform, fair performance criteria and tests and to avoid rigid, prescriptive criteria. Photovoltaics is an emerging technology; criteria written now must be able to accommodate devices and techniques not yet developed.

8289 (HCP/M2533—01/1) **Photovoltaic power systems market identification and analysis. Appendices.** (BDM Corp., McLean, VA (USA)). Nov 1978. Contract EG-77-C-01-2533. 226p. Dep. NTIS, PC A11/MF A01.

Topics include (1) present market analysis (detailed methodology, data, and results), (2) potential photovoltaic applications, (3) product/market scenario for rural electrification applications in Iran, (4) product market scenario for Mexican water pumping and rural electrification, (5) cost assumptions for conventional energy systems for underground cable for street and highway lighting, (6) breakeven cost analysis for p/v power systems for school applications, (7) description of conventional irrigation systems, and (8) technology diffusion in rural India. (WHK)

8290 **Application of photovoltaic roof shingles to residential and commercial buildings.** Shepard, N.F. Jr.; Sanchez, L.E. (GE, Philadelphia, Pa). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1582-1587(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The recent development of a shingle-type solar cell module makes it possible to incorporate easily photovoltaic power generation into the sloping roofs of residential or commercial buildings. These modules, which use a closely packed array of nineteen, 53-mm diameter circular solar cells, are capable of producing 101 watts/m^2 of module area at Standard Operating Conditions. This module performance is achievable by the use of solar cells with an average efficiency of 13.3 percent at 1 kW/m^2 air-mass-1.5 insolation and at a cell temperature of 28°C. When these modules are mounted on a sloping south facing roof which is insulated on the rear surface, the annual energy generated at the maximum power operating point will vary from 255.6 to 137.3 kWh/m^2 of module area depending on the site location.

8291 **Cost minimization of photovoltaic power supplies.** Rosenberg, S.A. (Bell-North Res Ltd, Ottawa, Ont). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1588-1592(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

This paper describes a design procedure for minimizing the cost of self-contained photovoltaic power supplies by optimum selection of the solar array/battery mix. The procedure takes into account variations in the relative and absolute costs of solar arrays and batteries, as well as local insolation data. General expressions are established to represent seasonal variations in solar cell output based on local monthly insolation data. Functions are then derived for determining the cost of solar cells and batteries in dollars per average watt output. The minimum cost system is then determined by differentiation.

8292 **Double roll-out solar array for space telescope.** Crabb, R.L.; Williams, C.J.H. (Eur Space Res and Technol Cent, Noordwij, Neth). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 2125-2130(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

This paper presents a general description of the 4 kW Solar Array under development in Europe for the 1984 Shuttle-launched,

NASA Space Telescope. The array is designed to meet the requirements of astronaut in-orbit maintenance and contingency operation; the particularly demanding requirement to function mechanically and electrically after 5 years in low earth orbit, having encountered some 30,000 thermal cycles; the requirement to satisfy the stringent constraints on array dynamics imposed by an astronomical observatory telescope with a pointing stability of thousandths of an arc second; and the need to be retractable, following a period of service in orbit, for return to earth in the Shuttle Orbiter bay.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 8377, 8378, 8385, 8573

8293 (UCLA—12/1213) **Worker health and safety in solar thermal power systems. III. Thermal energy storage subsystems.** Ullman, A.Z.; Sokolow, B.B.; Daniels, J.; Hurt, P. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Oct 1979. Contract EY-76-C-03-0012. 104p. Dep. NTIS, PC A06/MF A01.

The effects of the use of thermal energy storage (TES) subsystems in solar thermal power systems (STPS) on operating failures and on worker health and safety are examined. Relevant near- and medium-term designs for TES subsystems are reviewed. Generic failure events are considered by an event tree methodology. Three generic categories of initiating events are identified which can lead to release of storage fluids and other hazards. Three TES subsystem designs are selected for, and subjected to, analvsis. A fluid release event tree for a sensible heat TES subsystem using mixed media organic oil/crushed rock and sand, designed for the Barstow, CA, 10 MWe pilot plant, is developed. Toxicology and flammability hazards are considered. The effect of component failures, including ullage and fluid maintenance units, on subsystem safety is considered. A latent heat subsystem using $NaNO_3/NaOH$ as the working medium is studied, and relevant failure events delineated. Mechanical equipment failures including the scraped wall heat exchangers are examined. Lastly, a thermochemical TES subsystem using SO_2/SO_3 interconversion is considered. Principle hazards identified include mechanical failures and storage fluid release. The integrity of the system is found to depend on catalyst and heat exchanger reliability. Dynamic response to off-normal system events is considered.

8294 (UCLA—12/1214) **Worker health and safety in solar thermal power systems. IV. Routine failure hazards.** Ullman, A.Z.; Sokolow, B.B.; Hill, J.; Meunier, G.; Busick, Harold, III. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Sep 1979. Contract EY-76-C-03-0012. 111p. Dep. NTIS, PC A06/MF A01.

Routine failure events in selected solar thermal power system designs are examined, and their rates of occurrence estimated. The results are used to compare and rank the systems considered. Modules of 1 to 100 MWe are developed based on reference or other near-term designs. Technologies used include parabolic trough, parabolic dish, and central tower focusing; central and distributed power generation; and proximate and independent siting of power modules. Component counts and failure rates estimated include heat transfer system leaks, sensor failures, and mechanical and electrical component failures, such as pumps, motors, and wire and cable. Depending on the technology chosen, leak rates can approach 1000 per year per 100 MWe system capacity, while component failure rates can be several times that level. Within categories of failures, the various technologies can have rates differing by a factor of 1000 or more. A uniform weighting for the consequences of the various failure types is proposed. Under this weighting, central tower systems are most favored, followed by parabolic trough, parabolic dishes with dispersed power generation, and parabolic dishes with central power generation. This weighting does not account for possible variations in the technologies. A sensitivity analysis is used to bound the relative hazards of the various failure events required to invert one or more of the system rankings.

8295 **Nitinol heat engines for economical conversion of low grade thermal energy.** Cory, J.S.; McNicholas, J.L. (Cory Lab, Escondido, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 1998-2004(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Results of an investigation of Nitinol heat engine thermodynamic cycle performance are presented. The analysis is based upon extensive equation-of-state measurements and an irreversible thermodynamics algorithm formulated to account for internal friction (hysteresis) losses. Theoretical maximum efficiency for a Nitinol heat engine is shown to differ from Carnot by about one percent, showing conclusively that second law efficiency is not a limiting factor for application of Nitinol heat engines to low-grade thermal energy conversion. Performance is determined for present Nitinol material and is shown to be critically dependent on thermodynamic cycle selection. Efficiency for various practical cycles ranges to greater than 80 percent of Carnot, and specific work to greater than 2000 j/kgm/cycles.

CENTRAL RECEIVER

8296 (SAN—1745-1(Vol.1)) **Solar central receiver prototype heliostat: phase I. Volume I. Design, production, test. Final technical report.** (Solaramics, El Segundo, CA (USA)). Sep 1978. Contract ET-78-C-03-1745. 164p. Dep. NTIS, PC A08/MF A01.

The objective of this study and analysis was to optimize the structural design and performance of the heliostat so that satisfactory performance would be achieved over a system life of 30 years at minimum cost. Briefly, the design constraints can be broken into two categories; those of a transient nature and those of a steady-state nature. Transients include wind loading, local ambient vibrations, earthquakes, rain and hail loading, and temperature changes. The steady-state parameters include gravity, ice loading, and long-term weathering effects. For this study the reflective component of the SOLARAMICS heliostat consists of a foamed waste glass panel to which a thin glass reflector will be permanently bonded. Ten 4 ft x 10 ft panels and one 10 ft x 2 ft panel arrayed for 420 ft^2 reflecting surface are proposed in this design. The total heliostat array and controls are mounted on a vertical implanted hollow column (pedestal) made of a rigid ceramic material. This volume presents the summary and recommendations, preliminary design, production process, and bench tests. (WHK)

8297 (SAN—1745-1(Vol.2)) **Solar central receiver prototype heliostat: phase I. Volume II. Cost, trade-off, appendix. Final technical report.** (Solaramics, El Segundo, CA (USA)). Sep 1978. Contract ET-78-C-03-1745. 247p. Dep. NTIS, PC A11/MF A01.

The objective of this study and analysis was to optimize the structural design and performance of the heliostat so that satisfactory performance would be achieved over a system life of 30 years at minimum cost. Briefly, the design constraints can be broken into two categories; those of a transient nature and those of a steady-state nature. Transients include wind loading, local ambient vibrations, earthquakes, rain and hail loading, and temperature changes. The steady-state parameters include gravity, ice loading, and long-term weathering effects. For this study the reflective component of the SOLARAMICS heliostat consists of a foamed waste glass panel to which a thin glass reflector will be permanently bonded. Ten 4 ft x 10 ft panels and one 10 ft x 2 ft panel arrayed for 420 ft^2 of reflecting surface are proposed in this design. The total heliostat array and controls are mounted on a vertical implanted hollow column (pedestal) made of a rigid ceramic material. This volume presents cost estimates, the preliminary test plan, scope and schedule estimates, trade-off studies, and design drawings, sketches, and schematics. (WHK)

8298 (SAN—1745-2) **Solar central receiver prototype heliostat: phase I. Technical progress interim report.** (Solaramics, El Segundo, CA (USA)). May 1978. Contract ET-78-C-03-1745. 161p. Dep. NTIS, PC A08/MF A01.

The objective of this study and analysis is to optimize the structural design and performance of the heliostat so that satisfactory performance will be achieved over a system life of 30 years at minimum cost. The design constraints can be broken into two categories; those of a transient nature and those of a steady-state nature. Transients include wind loadings, local ambient vibrations, earthquakes, rain and hail loading, and temperature changes. The steady-state parameters include gravity, ice loading, and long-term weathering effects. During normal operation the reflective surface, the support structure, the drive and control system, and the foundation must be sufficiently rigid so that 95 percent of the reflected beam is received in the target area during daylight hours. Factors which will influence heliostat design during normal operation include flutter and vortex shedding due to normal wind conditions, ambient ground vibration, gravity loads, and temperature transients. During abnormal operation, the heliostat must be capable of withstanding loads imposed by maximum postulated winds both in operating orientation, and in stowed orientation; it must be capable of withstanding loads due to dust devils, rain, snow, hail and earthquakes. Structural integrity must not be threatened and realignment of the reflective surfaces is allowed only after occurrence of earthquakes. For this study the reflective component of the Solaramics heliostat consists of a foamed waste glass panel to which a thin glass reflector will be permanently bonded. Ten 4 ft x 10 ft panels and one 8 ft x 2 ft panel arrayed for 416 ft^2 of reflecting surface are proposed in this design. The total heliostat array and controls are mounted on a vertical implanted hollow column (pedestal) made of a rigid ceramic material. Project status is reported.

8299 (SAND—78-8185(Vol.1)) **Tower cost data for solar central receiver studies. Final report.** (Stearns-Roger Engineering Co.,

Denver, CO (USA)). Jun 1979. Contract EY-76-C-04-0789. 299p. Dep. NTIS, PC A13/MF A01.

This report details the work performed to establish solar receiver support tower costs and to investigate the relative importance of the following parameters: (1) materials (concrete and steel), (2) height, (3) weight of the receiver, (4) seismic ground acceleration, (5) wind velocity, (6) soil shear modulus, and (7) soil bearing capacity. The objective of this study was to obtain cost data to be used by Sandia Laboratories in a statistical model to evaluate the effects of the parameters listed. This objective was reached by designing 16 concrete and 17 steel solar receiver support towers, varying the parameters listed above. 29 of these design cases were intended to provide input to the statistical model; cases 17 thru 20 will be used to check the results. The costs of each tower and their foundations are presented. The costs ranged from a low of $40,000 for a structural steel tower, 120 feet high, supporting a receiver weighing 200 kips; to a high of $16,000,000 for a reinforced concrete tower, 1000 feet high, supporting a receiver weighing 8000 kips. The analytical procedure and input are described and itemized estimates are tabulated. (WHK)

8300 (SAND—78-8185(Vol.2)) **Tower cost data for solar central receiver studies. Supplement to final report.** (Stearns-Roger Engineering Co., Denver, CO (USA)). Jun 1979. Contract EY-76-C-04-0789. 612p. Dep. NTIS, PC A99/MF A01.

This report describes the work performed under the contract with Sandia Laboratory to establish solar receiver support tower costs and to investigate the relative importance of the following parameters: (1) materials (concrete and steel), (2) height, (3) weight of the receiver, (4) seismic ground acceleration, (5) wind velocity, (6) soil shear modulus, and (7) soil bearing capacity. The objective of this study was to obtain cost data to be used by Sandia Laboratories in a statistical model to evaluate the effects of the parameters listed above. This objective was reached by designing 16 concrete and 17 steel solar receiver support towers, varying the parameters listed above. 29 of these design cases were intended to provide input to the statistical model; cases 17 thru 20 will be used to check the results. This Supplement contains the printouts of the various computer runs that were performed for the study. Thrity-three separate tower designs were fed into the computer program. The resulting printouts are included in sequential order. (WHK)

8301 (SAND—78-8276) **Natural convection heat transfer from an external receiver.** Siebers, D. (Sandia Labs., Livermore, CA (USA)). Dec 1979. Contract EY-76-C-04-0789. 41p. Dep. NTIS, PC A03/MF A01.

A numerical solution of turbulent, two-dimensional, natural convection heat transfer for a high temperature, vertical surface is presented in this work. This is relevant to heat transfer from the receiver of a solar central receiver power plant on a calm day (no wind). It is the lower bound of convective loss from an external receiver. Application of wall suction to the receiver surface is also examined as a means of reducing convective loss. In the Appendix an analysis of the economic impact of energy loss from a receiver is presented. It demonstrates the importance of receiver performance with regard to solar central receiver plant cost. (MOW)

8302 (SAND—79-2043) **Acoustical studies of boiling instabilities in the prototype receiver for the Barstow Solar Pilot Plant.** Beattie, A.G. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 40p. Dep. NTIS, PC A03/MF A01.

An acoustic technique is used to search for proposed boiling instabilities in the prototype receiver for the Barstow 10 MW Solar Thermal Pilot Plant. The technique is shown to work and should be capable of measuring such instabilities when the receiver is tested at maximum proposed power levels.

8303 (SAND—79-8248) **Heliostat design cost/performance tradeoffs.** Fish, M.J.; Dellin, T.A. (Sandia Labs., Livermore, CA (USA)). Nov 1979. Contract EY-76-C-04-0789. 50p. Dep. NTIS, PC A03/MF A01.

The heliostat field comprises the most expensive subsystem of a solar central receiver power plant. Cost reductions might be achieved by either total heliostat redesign or component substitution in existing designs. This paper discusses the value of changing any of several design specifications in the current baseline glass/metal heliostat. Results are quantified in terms of the breakeven cost; i.e., the cost of a new design which will yield the same total system energy cost as the baseline system. Changes in mirror reflectivity, pointing accuracy, surface quality, canting and focusing strategy, heliostat size, and stow requirement are evaluated.

8304 (SAND—79-8259) **Materials performance in the Solar Central Receiver Pilot Plant.** Swearengen, J.C.; Robinson, S.L. (Sandia Labs., Livermore, CA (USA)). Oct 1979. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

The 10 MW/sub e/ Solar Central Receiver Pilot Plant, which is to be built at Barstow, California, is designed to provide development, fabrication, and operating data necessary to demonstrate the technical feasibility of the solar central receiver concept. The Pilot Plant consists of approximately 2000 reflecting heliostats which redirect solar insolation to a central receiver mounted on a tower. The energy collected by the receiver is used to produce superheated steam which is then used to generate electricity and/or charge storage. Performance of the plant will be studied during a five year test period scheduled to begin December 1981. The plant is being designed for a thirty year life. For the Pilot Plant, successful performance requires materials having not only the proper initial properties, but also having long-term stability in the presence of thermal, chemical, and mechanical environments. For purposes of this discussion materials concerns are categorized into four operating subsystems of the plant: collectors, receiver, storage, and electrical power generation.

8305 **Liquid metal heat pipes for the central solar receiver.** Bienert, W.; Wolf, D. (Dynatherm Corp, Cockeysville, Md). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1040-1049(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The feasibility of a heat pipe central solar receiver gas tubine plant has been studied. The conceptual system design consists of a semi-cylindrical cavity receiver and a gas-turbine generator mounted at the top of a reinforced tower located at the southern end of a heliostat field. Heat pipes are utilized to transform the concentrated solar flux within the receiver to flux levels compatible with heat transfer to the gaseous working medium of a Brayton cycle conversion system. The heat pipes are typically 6 cm in diameter and 1.1 m long. They must be capable of transporting an average load of 5.3 kW in the temperature range from 440° to 870°C. The peak transport requirement is 13.1 kW and the highest evaporator flux is 0.34 MW/m^2. A number of subscale and full scale heat pipes were developed and tested.

8306 **Heat pipe central solar receiver gas turbine plant.** Carli, G.; Zoschak, R.J. (Foster Wheeler Dev Corp, Livingston, NJ). *Proc.. Intersoc. Energy Convers. Eng. Conf.;* **2**: 1634-1640(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A conceptual design for a 10-MWe plant has been developed. The heat pipe central solar receiver uses heat pipes to transform the concentrated high solar heat flux at the receiver into a lower heat flux compatible with gas heat-transfer systems. Several Brayton cycles were studied to determine which cycles and operating conditions are technically and economically most viable for a central receiver power plant. An open gas cycle with an inlet turbine temperature of 815°C was selected. The turbine-generator and receiver are located at the top of a reinforced tower, with a north field of two-axis tracking heliostats. The system can be adapted for operation as a hybrid plant. The predicted cycle efficiency is 33 to 38 percent, and the overall solar-to-electric efficiency is 20 to 22.5 percent.

DISTRIBUTED COLLECTOR

8307 **Performance and economic risk evaluation of dispersed solar thermal power systems by Monte Carlo simulation.** Manvi, R.; Fujita, T. (Calif Inst of Technol, JPL, Pasadena). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1535-1540(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A preliminary comparative evaluation of dispersed solar thermal power plants utilizing advanced technologies available in 1985 to 2000 is under way. The solar power plants of 50 kW/sub e/ to 10 MW/sub e/ size are equipped with two axis tracking parabolic dish concentrator systems operating at temperatures in excess of 1000°F. The energy conversion schemes under consideration include advanced steam, open and closed cycle gas turbines, stirling, and combined cycle. The energy storage systems include advanced batteries, liquid metal, and chemical. This paper outlines a simple methodology for a probabilistic assessment of such systems.

8308 **Comparative evaluation of distributed-collector solar thermal electric power plants.** Fujita, T.; El Gabalawa, N.; Caputo, R.S.; Herrera, G.G. (Calif Inst of Technol, JPL, Pasadena). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1600-1607(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Distributed-collector solar thermal-electric power plants are compared by projecting power plant economics of selected systems to the 1990 to 2000 timeframe. The approach taken is to evaluate the performance of the selected systems under the same weather conditions. Capital and operational costs are estimated for each system. Energy costs are calculated for different plant sizes based on the plant performance and the corresponding capital and maintenance

costs. Optimum systems are then determined as the systems with the mininum energy costs for a given load factor. The optimum system is comprised of the best combination of subsystems which give the minimum energy cost for every plant size. Sensitivity analysis is done around the optimum point for various plant parameters.

TOTAL ENERGY AND HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 8573

8309 (SERI/TR—8016-1) **Solar thermal repowering utility value analysis. Final report.** Taylor, R.; Day, J.; Reed, B.; Malone, M. (Solar Energy Research Inst., Golden, CO (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). Dec 1979. Contract EG-77-C-01-4042. 225p. Dep. NTIS, PC A10/MF A01.

The retrofit of solar central receiver energy supply systems to existing steam-electric generating stations (repowering) is being considered as a major programmatic thrust by DOE. The determination of a government response appropriate to the opportunities of repowering is an important policy question, and is the major reason for the analysis. The study objective is to define a government role in repowering that constitutes an efficient program investment in pursuit of viable private markets for heliostat-based energy systems. In support of that objective, the study is designed to identify the scope and nature of the repowering opportunity within the larger context of its contributions to central receiver technology development and commercialization. The Supply and Integration Tasks are documented elsewhere. This report documents the Demand Task, determining and quantifying the sources of the value of repowering and of central receiver technology in general to electric utilities. The modeling tools and assumptions used in the Demand Task are described and the results are presented and interpreted. (MCW)

8310 **Conceptual design of the Fort Hood solar total energy: large scale experiment.** Black, D.L. (Westinghouse Electr Corp, Pittsburgh, Pa). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1514-1521(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Studies leading to the selection of a conceptual design are described for a Solar Total Energy System applied to five buildings within the 87,000 barracks complex located on the US. Army base at Fort Hood, Texas. The plant is required to produce 200-500 kW(e) for electrical load peaking and supply greater than 60 percent of the thermal load. The typical average loads are 51 x 10^6 Btu/day (summer, air conditioning), 48 x 10^6 Btu/day (winter, heating), and 20 x 10^6 Btu/day (year round domestic hot water). Numerous cycle arrangements and their effect on efficiency were studied and a computer program was developed to calculate solar utilization. Energy displacement and life cycle costs were analyzed. Supplementary studies included an evaluation of available solar collector designs, energy storage concepts, turbine and air conditioner comparisons, health and safety considerations and environmental effects. Operational, development, and procurement plans were also completed.

OCEAN THERMAL GRADIENT POWER PLANTS

8311 (CONF-790631—12) **Whole basin model of the Gulf of Mexico.** Blumberg, A.F.; Mellor, G.L. (Dynalysis of Princeton, NJ (USA)). 1979. Contract ET-78-C-02-5028. 11p. Dep. NTIS, PC A01/MF A01.

From 6. OTEC conference; Washington, DC, USA (19 Jun 1979).

An ocean model which is advanced beyond the current state of the art has been developed. Characteristics of the model include: a second moment turbulence closure model capable of accurate prediction of small scale turbulent mixing and derivative ocean features such as mixed layer temperature and depth; an algorithm which calculates the external (tidal) mode separately from the internal mode; a σ coordinate system with 20 levels in the vertical independent of depth; and coding deliberately designed for modern array processing computers. Some preliminary tests of the model as applied to the Gulf of Mexico are presented herein. The results to date are encouraging and indicate that the model should be useful in evaluating the environmental impact of many OTEC power plants deployed in the Gulf of Mexico or subsequently in other regions of the World Ocean. Conversely, the model should be useful in establishing oceanographic parameters (e.g., current shear) required by power plant designers.

8312 (RLO—2446-T1) **Compatibility studies for the system water-ammonia-titanium as related to ocean thermal energy conversion.** Owzarski, P.C.; Saaski, E.W.; Beck, T.R. (Sigma Research, Inc., Richland, WA (USA); Electrochemical Technology Corp., Seattle, WA (USA)). Dec 1977. Contract EY-77-C-06-2446. 62p. Dep. NTIS, PC A04/MF A01.

Materials for the heat exchangers in OTEC plants must be able to withstand a normally hostile marine environment on the seawater side and a nonaqueous working fluid on the evaporator side. Since titanium normally has shown outstanding corrosion resistance to seawater, and since ammonia appears to be the chosen OTEC working fluid, serious consideration has to be given to the compatibility of titanium to the two environments and to combinations of the two: mixtures of seawater in ammonia and ammonia in seawater, both mixtures being possible because of heat exchanger leaks. Due to a paucity of data for titanium corrosion in these mixtures, this project was initiated to fill part of the knowledge gap. Probably the most insidious and catastrophic corrosion failures are caused by stress corrosion cracking (SCC), a corrosion-accelerated crack propagation in metals under tensile stress. Therefore, the primary purpose of this work was to investigate the susceptibility of titanium to SCC in liquid ammonia and liquid containing small amounts of seawater. The objectives of the experimental project were to determine the effects of liquid ammonia/water/seawater mixtures on titanium specimen tensile failure. These effects were quantified in four ways: (1) percent elongation at failures; (2) percent reduction in area at failure; (3) electrode (specimen) potential versus elongation; and (4) microscopic measurement of secondary cracks (if any) in fractured specimens. The methodology consisted of subjecting a 1/8" diameter CP-titanium (Grade 4) rod immersed in the liquid ammonia solution to a slow tensile strain rate of 10^{-6} mm/mm s. Results are presented in detail. (WHK)

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 8378

8313 **Fossil fuel cost of solar heating.** Payne, P.R.; Doyle, D.W. (Payne, Inc, Annapolis, Md). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1650-1656(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

To build and install a solar heating or cooling system requires an "up front" investment of fossil fuel. The paper suggests that conventional solar heating systems may take as long as ten years to recover this investment from insolation, by which time the system may need extensive rework or replacement. (The energy payback time for solar hot water systems is roughly half this figure.) Of course, the figures can be made to vary widely with different assumptions, but so long as the energy cost of solar systems is comparable with the insolation they collect, they can hardly be regarded as a "solution" to the energy crisis, at least on a national value basis. This does not mean that solar heating systems are impractical. Some feasible, low energy cost designs are described.

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 8237, 8344, 8717

8314 (ALO—4125-11) **Passive solar energy collector. Final report.** Hauer, C.R.; Remillard, R.V.; Nichols, L.D. (EIKONIX Corp., Burlington, MA (USA)). 3 May 1978. Contract EG-77-C-04-4125. 38p. Dep. NTIS, PC A03/MF A01.

The objective of this research program was to validate the applicability of Poroplastic filled with wax and other wax filled plastic host materials as volumetric absorbers of solar energy, storing energy as a result of phase change. Moreover, it is attempted to show that a passive solar collector/convector of the Trombe Wall type storing a meaningful amount of heat can be fabricated using these materials. The research findings were encouraging, indicating that multilayer elements would absorb sufficient energy when exposed to the December afternoon sun in New England to undergo phase change at about 125°F. A second important finding was that the wax filled Poroplastic acts as a light valve upon undergoing phase change. Upon melting, optical transmission in the visible region of the spectrum increases by a factor of two making it possible to clearly see through the absorber layer. In the infrared portion of the spectrum, the change between radiant energy transmission from the liquid state to the solid state is a factor of 3 reduction. Thus, Poroplastic filled with wax can act as a passive curtain for Trombe Wall solar collectors isolating the warm wall surface of the solar collector from the nighttime sky as it solidifies. Reduction of nighttime radiation losses by this method could significantly improve performance of some types of solar energy systems. The research effort has shown that the goals of the encapsulated wax passive collector concept can be met and that such a collector/convector system can be designed and operated satisfactorily at reasonable cost. Based upon the results of the experimental work one estimates that such a collector could store between 240 and 300 Btu/

ft^2 in the form of latent heat of fusion of the wax at a weight of 2.6 lbs per square foot for the absorber/storage portion of the collector.

8315 (ALO—4296-T1) **Development of superior liquid coolants CCF-1. Semiannual technical progress report for September 1, 1978-February 28, 1979.** Hodges, R.M.; Marinik, J.A. (Dow Corning Corp., Midland, MI (USA)). 28 Feb 1979. Contract EM-78-C-04-4296. 30p. Dep. NTIS, PC A03/MF A01.

This semiannual report summarizes the results of physical property testing, FHSA toxicity testing and Biological Oxygen Demand (BOD) testing on five solar heat transfer fluids. The status of solar collector stagnation testing at New Mexico State University on four solar heat transfer fluids is reviewed. Cost effectiveness will be evaluated from the results of these and other tests yet to be undertaken, including stagnation performance in solar collectors. This economic evaluation will be presented in the final technical report at the conclusion of all contract tasks.

8316 (ALO—4298-1) **Vegetable oils: liquid coolants for solar heating and cooling applications. Semiannual report, September 29, 1978-March 31, 1979.** Ingley, H.A. (Florida Univ., Gainesville (USA). Solar Energy Lab.). Mar 1979. Contract EM-78-C-04-4298. 30p. Dep. NTIS, PC A03/MF A01.

As high temperature solar energy systems are developed for applications such as refrigeration, heating, cooking, electrical power generation, and industrial processes, the need for inexpensive, reliable heat transfer media (liquid coolants) will become more intense. At present petroleum distillates and synthetic coolants are being utilized for these purposes. Since the use of these substances represents a drain on our natural fuel resources, it has been proposed that vegetable oils, renewable byproducts of agriculture processes, be investigated for possible use as liquid coolants. This research project was implemented for the purpose of researching such a use. During the conceptual phase of the study, it was recognized that very little data are readily available for predicting the results of using vegetable oils as liquid coolants in high temperature solar systems. Therefore, the major thrust of the project will be to investigate several thermophysical properties of the four vegetable oils selected. Vapor pressures, specific heat, viscosity, density and thermal conductivity will be determined over a range of temperatures for corn, soybean, peanut and cottonseed oil. ASTM standard methods will be used for these determinations. Boiling point data and viscosity data have been determined for each of the four oils selected. Chemical analyses have been performed on samples of each oil. The samples were collected before and after each boiling point experiment so that any changes in composition could be noted. The tests include iodine number, fatty acid, and moisture content determination.

8317 (CONF-790202—, pp 67-84) **Current status of and future projections for solar technologies.** Reid, R.L. (Univ. of Tennessee, Knoxville). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Eight areas of solar energy technology applications are reviewed, and the opportunities for providing significant energy needs with these technologies are assessed. The high capital investments, which have been an economic deterrent, are expected to become competitive as conventional energy costs increase. The present status and projections are given for active space and water heating, passive space heating, cooling, industrial process heat, biomass, agriculture, power generation, and wind energy. The author recommends a hybrid active-passive system for space heating and notes that solar cooling is much more difficult than heating.

8318 (COO—4516-1) **Off-peak electric auxiliary heat for solar air-heating systems. Final report, June 1, 1977-December 31, 1978.** Jones, T.B.; Wilbur, P.J. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Jan 1979. Contract EG-77-S-02-4516. 51p. Dep. NTIS, PC A04/MF A01.

The performance of various solar auxiliary heating system options is examined by means of computer simulation. Systems which utilize off-peak electrical energy, which is stored in a thermal reservoir for use during the on-peak period, are examined. A storage reservoir which is separate from the solar reservoir is found to be preferable. Performance is generally not found to be sensitive to the time at which off-peak energy is available. Control schemes that predict energy requirements for a forthcoming on-peak period and account for energy in solar storage are shown to be preferable. A reservoir heater that can be staged so heating can be accomplished over the full duration of the on-peak period to supply different levels of energy is found to be desirable as a means of holding down peak demand costs. The system installed in CSU Solar House I for testing is described.

8319 **Solar architecture.** Franta, G.E.; Olson, K.R. (eds.). Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1978). 339p. (CONF-770598—).

From Workshop on solar energy applications; Aspen, CO, USA (27 May 1977).

Thirty-one papers are included. One was abstracted for EDB previously. Separate abstracts were prepared for twenty-six papers. Four papers on composting toilets and environmental education were not abstracted. (MHR)

8320 (DOE/CS/4131—1(Vol.3), pp 549-557) **Installed solar air conditioning, heating, hot water, and pool heating system for the LIFE Clinic.** Hudson, W.T. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

A 25 ton solar air conditioning system has been installed and made operational for a sports-medical center in Brandon, Florida. The system is expected to provide 80% of the building energy needs in air conditioning, space heat, and domestic hot water. The retrofit installation was completed, including acceptance test, in two months from the date the equipment was delivered to the site. One week site preparation work was required to adapt .he facility for te solar system. This time was nominal since the building had been constructed with the intent of installing a solar system at a later date. Condensor water heat from the chiller as well as collector heat is used to heat the 600,000 gal swimming pool during the cold weather. The combined energy uses offer a potential payback of twelve years. Project cost was approximately $272,772. System design and pattern are described.

8321 (DOE/NASA/TM—78243) **Development and testing of the Solar Control Corporation modular Controller and Solarstat Subsystem. Final report.** Hankins, J.D. (Solar Control Corp., Boulder, CO (USA)). Aug 1979. Contract EX-76-A-29-1037. 15p. Dep. NTIS, PC A02/MF A01.

This document summarizes the final results of contract NAS8-32258 Solar Control Corporation, for the additional development work on their existing Controller and Solarstat Subsystem for use with solar heating and cooling systems. It discusses the intended use of the final report, describes the deliverable end items, lists program objectives, and relates how they were accomplished. The report shows that the products developed are marketable and suitable for public use.

8322 (DOE/NASA/TM—78244) **Development and testing of the Sunkeeper Control Corporation integrated programmable electronic controller and hydronics package. Final report.** Hankins, J.D. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). 1979. Contract EX-76-A-29-1037. 21p. Dep. NTIS, PC A02/MF A01.

This document summarizes the final results of contract NAS8-32257 with Sunkeeper Control Corporation (now Andover Controls) of Andover, Massachusetts for the additional development work on their existing programmable electronic controller and hydronic package for use with solar heating and cooling systems. It discusses the intended use of the final report, describes the deliverable end items, lists program objectives and relates how they were accomplished. The report shows that the products developed are marketable and suitable for public use.

8323 (DOE/NASA/TM—78245) **Development, testing and certification of the sigma research, Maxi-Therm S-101 thermosyphon heat exchanger. Final report.** Hankins, J.D. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Oct 1979. Contract EX-76-A-29-1037. 21p. Dep. NTIS, PC A02/MF A01.

The Maxi-Therm S-101 is a thermosyphon liquid-to-air heat exchanger for use in heating systems in residential single-family dwellings and small commercial applications. It is a pumpless heating module which, when attached to a water storage tank, comprises a self contained heating unit. Electric resistance heating elements can be installed in the storage tank to provide a backup or off-peak heating system. (MOW)

8324 (DOE/NASA/TM—78246) **Development and testing of the Rho Sigma, Inc., microprocessor control subsystem. Final report.** Hankins, J.D. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Oct 1979. Contract EX-76-A-29-1037. 24p. Dep. NTIS, PC A02/MF A01.

This document summarizes the final results of Contract NAS8-32256 with Rho Sigma, Inc., Van Nuys, California, for the additional development work on their existing programmable electronic controller for use with solar heating and cooling systems. It discusses the intended use of the final report, describes the deliverable end items, lists program objectives, and relates how they were accomplished. The products developed are marketable and suitable for public use.

8325 (DSE—5216-T3) **Data handbook for the National Solar Energy Demonstration Program.** Christensen, D.L. (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy

Center). May 1979. Contract EM-78-S-01-5216. 97p. Dep. NTIS, PC A05/MF A01.

This preliminary document provides information in a matrix format which lists technical and programmatic data concerning the various project sites selected for the National Solar Energy Demonstration Program. It incorporates into one handbook the commercial, residential, and other demonstration projects which are now a part of the national program. It can be used as a reference source for technical and research purposes on a state-by-state basis.

8326 (SAN—1591-1) **Development of a solar desiccant dehumidifier. Volume 1. Summary. Volume 2. Detailed technical information. Technical progress report.** Gunderson, M.E.; Hwang, K.C.; Railing, S.M. (AiResearch Mfg. Co., Los Angeles, CA (USA)). 31 Mar 1978. Contract EG-77-C-03-1591. 176p. Dep. NTIS, PC A09/MF A01.

Research and development work aimed at the development of a solar desiccant dehumidifier is described in detail. The system features a rotary bed of granular silica gel and a rotary regenerator. The dehumidifier can be used for air conditioning through adiabatic saturation of the process airstream. Detailed technical information is presented in the appendices: (A) management, (B) review of the literature: state-of-the-art survey and SERI meeting, (C) review of the literature: adsorbent survey, (D) design requirements and evaluation criteria, (E) design requirements and evaluation criteria, single-family house model, (F) design requirements and evaluation criteria, economic model, (G) design requirements and evaluation criteria: conventional system models for comparison, (H) candidate cooling subsystems, (I) subsystem computer model, (J) subsystem performance map, and (K) subsystem preliminary design. (WHK)

8327 (SERI/TP—49-065, pp 103-106) **Practical solutions to solar heating of a commercial greenhouse.** Collins, D.L. (Solargenics, Inc., Chatsworth, CA). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

Solargenics' project, using a commercial greenhouse in El Paso, Texas, has evolved a series of techniques for building and sizing a hybrid solar system which has a reasonable probability for achieving broad commercial success. The key to developing a universal system was the creation of a simple scalable sizing methodology. The sizing technique has been applied to greenhouses from 3,000 to 250,000 square feet with verifiable results. Techniques were also developed for the utilization of low temperature energy which is commonly found in a greenhouse. Over 50% of the greenhouse heating load is derived from recovered energy. No technical development program can achieve meaningful results unless it meets the specialized needs of the end user. The engineering phase of this program evolved a family of devices which satisfy the operational needs of Controlled Environment Agriculture.

8328 (SERI/TP—49-065, pp 107-116) **Construction of the Kube Pak solar heating demonstration.** Mears, D.R.; Roberts, W.J.; Kendall, P.W.; Simpkins, J.C. (Rutgers Univ., New Brunswick, NJ). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

Based upon the encouraging results of research on the solar heating of greenhouses at Rutgers University, a demonstration project has been constructed at the Kube Pak Corporation, Allentown, New Jersey. A new greenhouse addition of 0.54 hectares (58,000 sq ft) has been built. The entire greenhouse floor is utilized for storage of energy in warm water and is the primary heat exchange surface. Movable plastic curtains provide insulation at night. The low cost solar collectors are made of air inflated plastic films and are designed to heat water to 20 to 25°C, the normal range of operation of the floor system. Performance of the research prototype indicates that the 1,000 m^2 (11,000 ft^2) of solar collectors should provide somewhat more than one half the heat required for one quarter of the greenhouse area.

8329 (SERI/TP—49-065, pp 125-131) **Solar heating of commercial greenhouses.** Staton, B.G. (Lockheed-Huntsville Research & Engineering Center, AL). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

This application of solar energy to commercial agriculture has focused on the heating of commercial greenhouses. Specifically, a flat plate liquid collector solar system has been built for heating an 803.6 m^2 (8650 ft^2) greenhouse at the Ulery Greenhouse Company in Springfield, Ohio. The heating system contains 557.4 m^2 (6000 ft^2) of low cost collectors mounted external to the greenhouse. Thermal storage is contained in 94.6 m^3 (25,000 gal) of water located in an in-the-ground concrete tank. Approximately 5 x 10^5 MJ (4.8 x 10^8 Btu) of energy can be collected and stored during an average heating season. This represents 60% of the greenhouse heating needs. Auxiliary heating is provided by a steam system used previously for primary heating. The predicted solar energy cost (before tax) is $0.02/MJ ($25/MBtu). This is based on an installed system cost of approximately $70,000. A data acquisition system is installed to acquire and compute the necessary performance parameters.

8330 (SOLAR/1018—79/14) **Solar energy system performance evaluation.** Hughes, J.E. (International Business Machines Corp., Gaithersburg, MD (USA)). 1979. Contract EG-77-C-01-4049. 66p. Dep. NTIS, PC A04/MF A01.

The Stewart-Teele-Mitchell site is a single-family residence in Malta, New York. The home has approximately 1900 square feet of conditioned space. Solar energy is used for space heating the home and preheating domestic hot water (DHW). The solar energy system has an array of flat-plate collectors with a gross area of 432 square feet. The array faces south at an angle of 45 degrees to the horizontal. A glycol/water solution is the transfer medium that delivers solar energy from the collector array to a heat exchanger. Water is then used as the transfer medium that delivers solar energy from the heat exchanger to storage, and to the space heating and DHW loads. Solar energy is stored in the basement in a 1000-gallon insulated tank. Preheated city water is stored in a 75-gallon preheat tank and supplied, on demand, to a conventional 40-gallon DHW tank. When solar energy is insufficient to satisfy the space heating load, an oil-fired furnace provides auxilary energy for space heating. Similarly, an electrical heating element in the DHW tank provides auxiliary energy for water heating. (MOW)

8331 (SOLAR/1030—79/14) **Solar energy system performance evaluation.** Labbe, N.M. (International Business Machines Corp., Gaithersburg, MD (USA)). 1979. Contract EG-77-C-01-4049. 70p. Dep. NTIS, PC A04/MF A01.

This Solar Energy System Performance Evaluation Report presents the results of a thermal performance analysis of the Chester West solar energy system. The analysis covers operation of the system from September 1978 through March 1979. The Chester West solar energy system provides space heating and domestic hot water to a single-family dwelling located in Huntsville, Alabama. Section 2 presents a summary of the overall results. A system description is contained in Section 3. Analysis of the system thermal performance was accomplished using a system energy balance technique described in Section 4. Section 5 presents a detailed assessment of the individual subsystems applicable to the site. (MOW)

8332 (SOLAR/1056—79/14) **Solar energy system performance evaluation.** Fontaine, D.C. (International Business Machines Corp., Gaithersburg, MD (USA)). 1979. Contract EG-77-C-01-4049. 71p. Dep. NTIS, PC A04/MF A01.

M. F. Smith Associates is a single-family residence in Jamestown, Rhode Island. The home has approximately 1752 square feet of conditioned space. Solar energy is used for space heating the home and preheating domestic hot water (DHW). The solar energy system has an array of flat-plate collectors with a gross area of 512 square feet. The array faces 15 degrees west of south at an angle of 45 degrees to the horizontal. Water is the transfer medium that delivers solar energy from the collector array to storage and to the space heating and hot water loads. Solar energy is stored in a 3150-gallon concrete storage tank. City water is preheated in storage and in heat exchanger HW1, which receives energy from a coil at the output of the heat pump compressor. Preheated water is supplied, on demand, to a conventional 82-gallon DHW tank. Solar-heated water from the storage tank is directed to a heat pump or to an hydronic heat exchanger to provide space heating. (MOW)

8333 (SOLAR/2014—79/60) **Solar project cost report.** (Mueller Associates, Inc., Baltimore, MD (USA); PRC Energy Analysis Co., McLean, VA (USA); IBM Federal Systems Div., Huntsville, AL (USA)). 21 Apr 1978. Contract W-31-109-ENG-38;EX-76-C-01-2389. 34p. Dep. NTIS, PC 03/MF A01.

This report provides cost information for the solar heating and hot water system at the Blakedale Professional Center located in Greenwood, South Carolina. The solar energy system provides space heating and domestic hot water for half the office space at the Blakedale Professional Center. The system construction was concurrent with the building construction, and the system is a new installation. The system utilizes three banks of collectors, with a net area of 928 ft^2 and a gross area of 954 ft^2, roof mounted in a sawtooth configuration with aluminized mylar reflectors on the backs of the supports. The collectors are double glazed and have copper absorber plates with a nonselective black coating. Storage capacity is 5,000 gallons and is provided by a steel storage tank covered with polyurethane insulation buried underground approximately 50 feet from the building. The construction costs of this solar space heating project are presented.

8334 (SOLAR/2036—79/50) **Solar project description.** Hale, H.J. (PRC Energy Analysis Co., McLean, VA (USA); IBM Federal Systems Div., Huntsville, AL (USA); Mueller Associates, Inc., Baltimore, MD (USA)). 19 Jan 1979. Contract EG-77-C-01-2522. 50p. Dep. NTIS, PC A03/MF A01.

The Page Jackson Elementary School in Charles Town, West Virginia has a solar energy system for space heating and cooling for

the 52,600 square foot building. The 11,215 square feet of PPG double-glazed, flat-plate collectors face south at a 45° angle to the horizontal. The collectors are piped in reverse return with insulated copper branch piping. The collectors are attached to the sawtooth framing and glass mirrors are attached to the north side of the frame. Copper absorber plates, with a black chrome selective coating, are soldered to copper tubing. The two 1/8 inch Herculite tempered glass glazings are separated from each other and the absorber plate by 3/8 inch airspaces. There is a 6 inch fiberglass insulating batt placed behind the uninsulated collectors. Overheat protection is provided by circulating storage water. Freeze protection is provided daily by automatically draining the collectors and the exterior piping after the collector pump turns off. Two insulated 10,000 gallon steel storage tanks are located in the mechanical equipment room and are connected in series. The tanks are insulated with 6 inches of sprayed urethane insulation which has an asbestos coating. No chilled water storage is provided. Space heating is provided by circulating warm storage water through five air handling units. A 780,000 Btu/hr oil-fired boiler is used for additional heating. Space cooling is provided by pumping hot storage water to a 100-ton absorption chiller. (MHR)

8335 (SOLAR/2036—79/60) **Solar project cost report.** (Mueller Associates, Inc., Baltimore, MD (USA); PRC Energy Analysis Co., McLean, VA (USA)). 19 Jan 1979. Contract EG-77-C-01-2522. 34p. Dep. NTIS, PC A03/MF A01.

This report provides detailed cost information for the Page Jackson Elementary School solar space heating and cooling project located in Charles Town, West Virginia. The solar energy system cools and heats the approximately 52,600 ft² school. The system was designed as an integral part of the building at the time the building was designed. The 11,215 ft² of collectors were manufactured by the PPG Industries, Inc. and serve as both part of the roof of the building and the solar collectors. For cooling, water is chilled by a 100-ton Trane packaged absorption water chiller. Solar heated water for use in space cooling and heating is stored in two 10,000 gallon hot water storage tanks. (MOW)

8336 (SOLAR/2048—79/60) **Solar project cost report.** (Mueller Associates, Inc., Baltimore, MD (USA); PRC Energy Analysis Co., McLean, VA (USA)). 16 Mar 1979. Contract EG-77-A-01-4027;EG-77-C-01-2522. 34p. Dep. NTIS, PC A03/MF A01.

This report provides detailed cost information for the solar space heating project at the Concord Light Plant in Concord, Massachusetts. The system utilizes 92 flat-plate air collectors, manufactured by Sunworks, having a net area of 1737 square feet. Solar energy is stored in a rock thermal storage bin of 1210 cubic feet which is located in a corner of the garage. Auxiliary energy is provided by electrical resistance heaters. Category costs are listed for the Town of Concord, General Contractor's materials, General Contractor's labor, and subcontract costs. The subcontract costs include materials, labor, overhead and profit costs for the steelwork in the collector support system, the flashing and caulking, the storage bin masonry, the electrical power wiring, the controls (system), and the roofing. A further breakdown of these costs was obtained for the steelwork subcontract. The construction cost for this project was $99,350 not including general contractor overhead and profit and general and administrative costs. (MOW)

8337 **Fundamentals of solar energy technology.** Yellott, J.I. Huntsville, AL; University of Alabama (1979). 50p. (NP—24041). National Aeronautics and Space Administration, Huntsville, AL.

A series of lectures given at the Solar Energy Seminar at the Marshall Space Flight Center, Huntsville, Alabama, is documented. Topics include solar radiation measurement, applications of solar energy, passive systems, passive systems in architecture, active systems, solar cooling, residential applications of solar heating and cooling, solar refrigeration, additional passive concepts, heat storage processes, and testing of solar energy equipment. (WHK)

8338 **Passive solar heating of buildings.** Balcomb, D.; Hedstrom, J.C.; McFarland, R.D. pp 76-95 of Energy conservation through building design. Watson, D. (ed.). New York, NY; McGraw-Hill, Inc. (1979).

Various types of passive systems are described. A mathematical simulation analysis of several systems is discussed. These include solid walls, Trombe walls, and Trombe walls with controls. (MOW)

8339 **Liquid desiccant solar air conditioner and energy storage system.** Robison, H.I. (Univ of SC, Coastal Carolina Energy Lab, Conway). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1620-1622(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A liquid desiccant air conditioning system has been designed and is being constructed for testing. The absorbate chosen is water; the absorbent is triethylene glycol. Shallow-well water removes sensible heat. Direct solar radiation reactivates the dilute sorbent solution as it flows down corrugated trickel collectors. Insolation is used for mass transfer, and very little energy is lost to the ambient air stream as sensible heat. Parasitic losses are small as no blower is necessary in the regenerator and heat exchangers recover sensible heat absorbed by the glycol. A small, concentrated solution, flywheel-storage system makes continuous operation possible.

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

8340 (DOE/CS/32199—2) **Solar production of industrial process steam ranging in temperature from 300°F to 550°F (Phase I). Volume 2. Appendices. Final report.** (Foster Wheeler Development Corp., Livingston, NJ (USA)). 30 Jun 1979. Contract ET-78-C-03-2199. 232p. Dep. NTIS, PC A11/MF A01.

This volume contains the following appendices: (1) equipment requisitions, (2) instrument list, (3) mechanical subcontract requisition, (4) electrical subcontract requisition, (5) site preparation and subcontract requisition, (6) building subcontract requisition, and (7) job specifications. (MOW)

8341 (DOE/CS/32199—3) **Solar production of industrial process steam ranging in temperature from 300°F to 550°F (Phase I). Volume 3. Appendices (cont). Final report.** (Foster Wheeler Development Corp., Livingston, NJ (USA)). 30 Jun 1979. Contract ET-78-C-03-2199. 243p. Dep. NTIS, PC A11/MF A01.

The following appendices are included: (1) instruments, (2) electrical specifications, (3) protective coverings, (4) welding requirements, (5) engineering specifications, and (6) administrative. (MOW)

8342 (SAND—79-1292C) **Advantage of loan leveraging in commercial solar process heat applications.** Schimmel, W.P. Jr.; Bergeron, K.D. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 5p. (CONF-791024—6). Dep. NTIS, PC A02/MF A01.

From Solar industrial process heat conference; San Francisco, CA, USA (31 Oct 1979).

In a majority of the solar/thermal studies to date, a utility economic methodology has been used to assess the potential of solar power systems. The utility sector is precluded from taking advantage of loan leveraging because the effective rate of return is artificially set. Utilities are regulated by public commissions and thus must finance new capital investments according to a prescribed set of rules on after tax cost of capital and fixed charge rates. Commercial ventures have no such externally imposed constraints and make decisions for capital expenditures which include the effect of loan leveraging. The relevant parameters for a commercial institution are interest rate on debt, a discount rate which accounts for risk, and the effect of favorable tax incentives. An expression is developed for a capital cost factor which contains these parameters. Results are shown for various downpayments and discount rates. It will be shown that the effect of loan leveraging can be substantial in affecting the penetration of solar process heat into the commercial energy market. In addition, the relation between loan leveraging and risk is investigated.

8343 (SERI/PR—353-212) **Market characterization of solar industrial process heat applications. Progress report, second quarter 78-79.** Ketels, P.A.; Reeve, H.R. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1979. Contract EG-77-C-01-4042. 96p. Dep. NTIS, PC A05/MF A01.

In order to realistically assess the market penetration potential for solar industrial process heat (IPH), the energy use and technical requirements of current industrial processes must be cataloged to provide an understanding of the existing industrial network. In addition, it is necessary to determine geographical location of industry and the investment decision criteria employed by industry for the purpose of establishing cost goals for solar energy that are realistic and comparable to accepted industrial financial practice. Included in this progress report are an analysis and summary of available recent data sources and studies related to IPH to determine the industries that have the largest energy requirements for process heat in the temperature ranges of <550°F and 550°F to 1100°F. In addition to the summary of findings based upon data sources analyzed, the study objectives, scope, and methodology are presented. A summary table is presented also that identifies the temperature ranges that are required for specific industrial applications arranged according to standard industrial classification (SIC) codes. The material presented represents completion of the initial phase of this program, review and analysis of available literature and previously completed studies. Thus, the initial phase presents a screening of industrial applications according to SIC code, annual energy consumption, and end-use process temperature according to geographical location in the 13 most energy-intensive industrial states. During the second phase of the program, trade associations and other institutions related to the industries listed in the summary table will be identified and contacted.

8344 (SERI/TP—49-065) **Solar industrial process heat conference. Proceedings: Volume I.** (Idaho National Engineering Lab.,

Idaho Falls (USA); Solar Energy Research Inst., Golden, CO (USA)). 1978. Contract EG-77-C-01-4042. 206p. (CONF-781015—(Vol.1)). Dep. NTIS, PC A10/MF A01.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

Separate abstracts were prepared for each of the nineteen papers presented. (MHR)

8345 (SERI/TP—49-065, pp 15-23) **Solar energy for industrial process hot water.** Vindum, J.O.; Bonds, L.P. (Acurex Corp., Mountain View, CA). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

Acurex Corporation has designed, constructed and is operating a solar energy system for supplying industrial process hot water. At the Campbell Soup plant in Sacramento, California, solar-heated water is used to wash empty and full soup cans on one of the production lines. The solar collector field is made up of a combination of single-glazed, nonselective flat-plate and parabolic trough concentrating collectors. A complete data acquisition system provides on-site logging and display.

8346 (SERI/TP—49-065, pp 25-37) **Commercialization aspects of solar process hot water systems for the textile industry.** Trice, J.B.; Cohen, A.D. (General Electric Co., King of Prussia, PA). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

A solar hot water process heat application for a textile plant located in LaFrance, South Carolina. The system was put into operation in June 1978 and is currently being evaluated. Using cost and performance data from the LaFrance project, an economic analysis has been made to determine the factors required to meet acceptable industry standards for payback periods which are typically 5 years or less in the textile industry. With favorable government tax incentives, solar process hot water systems begin to be competitive with conventional systems in certain parts of the country in the near future. A list of requirements for a program to accelerate development and commercialization of the solar system has been prepared. Suggestions for a proposed program have been outlined, based upon the requirements.

8347 (SERI/TP—49-065, pp 39-49) **Agricultural industrial hot air system.** Carnegie, E.J.; Pohl, J.; Niles, P. (California Polytechnic State Univ., San Luis Obispo). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

Preliminary operating tests and construction costs are examined for a 1951 m^2 (21,000 sq ft) solar collector field, a 396 m^3 (14,000 cu ft) heat storage facility, a heat recovery unit and all associated components. The future potential of these types of system in the industrial sector are also examined.

8348 (SERI/TP—49-065, pp 51-61) **Solar heated lumber dry kiln.** Robertson, S.J.; Merrifield, D.V. (Lockheed-Huntsville Research & Engineering Center, AL). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

A solar energy system was designed, installed and is currently being tested for supplying heat to two 50,000 board foot capacity lumber dry kilns. The solar energy system consists of 2500 square feet of double glazed flat plate collectors with a black chrome selective coating, a 5000 gallon steel storage tank for storing heated water and approximately 650 feet of fin-pipe heat exchangers in each kiln. The solar energy system has been operating and supplying heat to the kilns since November 1977. The system has operated, in general, as anticipated. Some problems have developed but have been corrected. The collection of data has been hampered by problems with instrumention and the data acquisition computer, but the collected data indicate that system performance is about as predicted. The collector efficiencies have averaged about 45% during the time that good data were available, and the energy supplied to the kilns averaged about 2 million Btu per day, about 44% of the energy requirement for one kiln.

8349 (SERI/TP—49-065, pp 63-78) **Process drying of soybeans using heat from solar energy.** Guinn, G.R. (Teledyne Brown Engineering, Huntsville, AL). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

The design and performance of an air-based solar energy system which augments conventional dryers used in the process drying of soybeans are described. Preliminary performance results for the 13,104-ft^2 array in the months of June and July indicated that efficiency was degraded by about three percentage points due to the accumulation of plant effluents over 40 days. Fossil fuel savings was low (approximately 373 gal of No. 5 oil) because of low utilization during extended periods of plant maintenance. Suggested improvements to this type of system include studies to identify collector design concepts responsive to the requirements of industrial process heat. Suggestions for future research and development efforts include techniques for cleaning panels of contaminants peculiar to industrial applications.

8350 (SERI/TP—49-065, pp 79-95) **Application of solar energy to the dehydration of onions.** Graham, B.J.; Saarlas, M.; Sierer, P.D. Jr. (Trident Engineering Associates, Inc., Annapolis, MD). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

Trident Engineering Associates, in cooperation with McCormick and Company, Inc., and its subsidiary, Gilroy Foods, Inc., is designing, installing, and evaluating a DOE-sponsored solar energy demonstration system for application to a food dehydration process. The system will be installed at the Gilroy Foods onion and garlic dehydration plant in Gilroy, California. The collector array provides for 562m^2 (6048 ft^2) of Owens-Illinois evacuated tube collectors and is estimated to contribute 2.47 x 10^{12} J/yr (2340 MBtu/yr) to the dehydration process.

8351 (SERI/TP—49-065, pp 133-140) **Textile drying at WestPoint Pepperell using solarized can dryers.** Mitchell, P.D. (Honeywell, Inc., Minneapolis, MN). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

A solar energy collection system is described for providing process heat to a textile drying process. The solar collection subsystem uses 24 parabolic trough, single axis tracking, concentrating collectors to heat water in a high temperature water (HTW) loop. A steam generator is fueled with HTW to produce process steam. The process being solarized is textile drying using cylindrical can dryers. The can dryers are part of a slashing operation in a WestPoint Pepperell mill in Fairfax, Alabama.

8352 (SERI/TP—49-065, pp 141-150) **Industrial process heat demonstration at the Home Laundry, Pasadena, California.** Eldridge, B.G. (Jacobs-Del Solar Systems, InC., Pasadena, CA); Roos, C.F.; Goranson, G.G. 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

Objectives and design considerations are given for the DOE Home Laundry project in Pasadena, California. The solar energy system is based on 6496 sq ft of tracking DEL concentrating solar energy collectors. The DEL collector has a 2 ft x 8 ft aperture, fixed receiver and utilizes parabolic back-silvered glass concentrating mirrors. The system will be placed over the existing facility and is designed to assist the existing gas-fired boiler system by furnishing 110 psig steam for laundry and dry cleaning service. The system will furnish 25% of the annual steam and 21% of the annual combined steam and hot water. A conservative life-cycle cost analysis indicates a simple payback period of thirteen years. Final design of the system is complete and operation is scheduled for early 1979. A strategy is described for economical, future upgrading of initial systems and demonstration of advances in solar thermal system technology. Illustrations and a schematic diagram are included for the Home Laundry.

8353 (SERI/TP—49-065, pp 151-160) **Solar production of low pressure industrial process steam for processing of orange juice.** Trice, J.B.; Cohen, A.D. (General Electric Co., King of Prussia, PA). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

A solar low pressure process steam system is described for an orange juice pasteurizer located at Tropicana Industries complex in Bradenton, Florida. Solar energy will be collected by a 10,000 square foot array using evacuated tubes located at the focus of a 3X concentration cusp-type reflector. Water at temperatures up to 204°C (400°F) will transfer the collected energy directly to an unfired boiler which will generate steam at pressures up to 135 psig. The rationale for selection of the particular process location is outlined. Unique collector requirements are identified, and the approach to meeting these requirements is presented. A brief discussion of the future economic outlook is given, and recommendations for further work are presented.

8354 (SERI/TP—49-065, pp 161-173) **Solar energy for industrial process steam.** Youngblood, S.B. (Acurex Corp., Mountain View, CA). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

The technical and economic feasibility of generating low-pressure steam, 446 K, 862 kPa (345°F, 125 psia) for an industrial process is being demonstrated at the Johnson & Johnson plant in Sherman, Texas. Phase I (Analysis and Design) was completed in June 1978; Phase II (Fabrication and Installation) is currently in progress and should be completed in early 1979.

8355 (SERI/TP—49-065, pp 175-185) **Limiting factors for the near-term potential of solar industrial process heat.** Casamajor, A.B.; Wood, R.L. (Lawrence Livermore Lab., CA). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

A small scale field study of potential applications for solar industrial process heat has been conducted. From this study, it has been determined that, while many industrial processes appear to be potential candidates for the application of solar energy, there are several, common, site-specific limitations that reduce this potential. These limitations include: limited land area, waste heat available on site, and the usual economic and institutional factors. A need for additional work is identified.

8356 (SERI/TP—49-065, pp 197-202) **Evaluation of regional economic and social impacts resulting from industrial shutdowns due to lack of fuel.** Ehrhardt, R.F.; Kornreich, T.R.; Lemont, S. (JBF Scientific Corp., Arlington, VA). 1978.

From Solar industry heating procen conference; Denver, CO, USA (18 Oct 1978).

The regional economic and social impacts attributable to the shutdown of industrial plants due to a shortage of conventional fuel supplies are defined and evaluated. Specific emphasis will be placed on the textile industry in the Southeastern United States. The methodology under development involves the combination of a case study approach with a system for analyzing social and economic impacts (SASEI). The SASEI represents a specialized analytical framework for performing the required evaluations and is composed of the social and economic parameters which are most meaningful in measuring the desired impacts. The specific quantitative impacts of industrial natural gas curtailments during the winter of 1976-1977 will be developed for specific sub-regions in the Southeast. In addition to the impact assessment, this study addresses two other issues. The first involves a characterization of textile industry attitudes and practices with respect to the implementation of precautionary strategies to avert potential future fuel shortages. The second relates to an assessment of the feasibility of utilizing persently available forecasting methods for realistically projecting fuel curtailment scenarios. The outputs of this study will provide a measure of socio-economic impacts attributable to conventional fuel shortages in the recent past, the outlook for potential future curtailments, industry prespectives on the problem and may serve as a catalyst for promoting the commercialization of solar industrial process heat systems.

8357 (SERI/TP—333-500) **Implementation of solar industrial process heat: summary.** Kearney, D.W. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1979. Contract EG-77-C-01-4042. 4p. Dep. NTIS, PC A02/MF A01.

The implementation of solar industrial process heat systems will depend not only on the successful development of reliable and efficient solar technologies, but also on the intelligent and sound application of process engineering principles. This poses an important challenge which must be given increasing attention if SIPH systems are to be adopted by industry. (MOW)

WATER HEATING

REFER ALSO TO CITATION(S) 8320, 8330, 8331, 8332, 8333, 8335, 8337, 8384

8358 (ALO—4089-T1) **Double-exposure collector system. Technical progress report, October 1-December 31, 1978.** Larson, D.C.; Savery, C.W. (Drexel Univ., Philadelphia, PA (USA)). 30 Jan 1979. Contract EG-77-G-04-4089. 12p. Dep. NTIS, PC A02/MF A01.

A retrofit solar water-heating system has been installed in a three-story apartment building at Drexel University. The system employs two conventional collector banks (10 PPG collectors) mounted at the latitude angle for Philadelphia of 40 deg from the horizontal and two double-exposure collector (DEC's) mounted vertically in mirrored enclosures. Although the DEC units are being used for year-round domestic water-heating for the building, they are designed to provide maximum output in the winter and are therefore well-suited to solar space heating applications. Instrumentation for testing the collectors has been available in the apartment building. The system was operated on two nights to determine collector total loss coefficients and heat capacities. Loss coefficients of 5.0 and 7.2 W/m^{2}C and heat capacities of 14,400 and 10,800 J/m^{2}C were obtained for the PPG and DEC collectors respectively. A theoretical study of optimal mirror placements for conventional collectors was also completed during the quarter. This study is important because many systems presently operating employ non-optimal mirror-panel configurations and the results of the study could be used to significantly improve the performance of these systems.

8359 (ALO—4089-T2) **Double-exposure collector system. Technical progress report, April 1-June 30, 1978.** Larson, D.C.; Savery, C.W. (Drexel Univ., Philadelphia, PA (USA)). 25 Jul 1978. Contract EG-77-G-04-4089. 22p. Dep. NTIS, PC A02/MF A01.

A retrofit solar water-heating system has been installed in a three-story apartment building at Drexel University. The system employs two conventional collector banks (10 PPG collectors) mounted at the latitude angle for Philadelphia of 40 deg from the horizontal and two double-exposure collectors (DEC's) mounted vertically in mirrored enclosures. Although the DEC units are being used for year-round domestic water heating for the building, they are designed to provide maximum output in the winter and are therefore well-suited to solar space heat applications. Instrumentation for testing the DEC units has been developed and installed in the apartment building. The temperature sensors have been calibrated and regular data collection has begun. Some of the performance data acquired in June and July is presented and analyzed. The performance of the DEC units has been excellent during these summer months. A computer program has been developed for performance calculations for a variety of mirror configurations and latitude locations. Some preliminary results are presentd for latitudes 35, 40 and 45 deg.

8360 (ALO—4089-T3) **Double-exposure collector system. Technical progress report, April 1-June 30, 1979.** Larson, D.C.; Savery, C.W. (Drexel Univ., Philadelphia, PA (USA)). 30 Jul 1979. Contract EG-77-G-04-4089. 58p. Dep. NTIS, PC A04/MF A01.

A retrofit solar water-heating system has been installed in a three-story apartment building at Drexel University. The system employs two conventional collector banks (10 PPG collectors) mounted at the latitude angle for Philadelphia of 40 deg from the horizontal and two double-exposure collectors (DEC's) mounted vertically in mirrored enclosures. Although the DEC units are being used for year-round domestic water heating for the building, they are designed to provide maximum output in the winter and are therefore well-suited to solar space heating applications. Instrumentation for testing the two types of collectors has been operating in the apartment building for some time. Summer performance data have been obtained which indicate that, at a minimum, the DEC units will provide twice as much useful heat output per panel as conventional collectors. In addition some results for an overcast day showed that comparable relative performance could be expected on these days.

8361 (SOLAR/1017—79/14) **Solar energy system performance evaluation.** Fu, C.M. (International Business Machines Corp., Gaithersburg, MD (USA)). 1979. Contract EG-77-C-01-4049. 66p. Dep. NTIS, PC A04/MF A01.

The Facilities Development Gas Company site is a three-story, multifamily condominium consisting of 31 units in San Diego, California. Solar energy is used for preheating domestic hot water (DHW) for the complex. The solar energy system has an array of flat-plate collectors with a gross area of 520 square feet. The area faces south at an angle of 42 degrees to the horizontal. Potable water is the transfer medium that delivers solar energy from the collector array to storage. Solar energy is stored underground in an insulated 1000-gallon glass-lined tank. Preheated water from the storage tank is supplied, on demand, to 31 conventional 52-gallon DHW tanks. When solar energy is insufficient to satisfy the hot water load, two electrical heating elements, energized separately within the individual DHW tanks, provide auxiliary energy for water heating. (MOW)

8362 **Thermosyphon solar water heating system under Brazilian conditions.** Orlando, A.F.; Magnoli, D.; Goldstein, L. Jr. (Cent de Tecnol Promon, Rio de Janeiro, Braz). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1628-1633(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A double loop thermosyphon solar water heater has been developed and its performance measured. The collectors are of the double glazing flatplate type with a roll-bond aluminum absorber employing low-cost materials. The working fluid (corrosion inhibited water) flows in a closed loop consisting of the collectors and a shell-and-tube heat exchanger. Cold water is heated in the secondary loop of the heat exchanger and is stored in a hot water tank located below the collector level, thus improving architectural aspects of the solar water heating system for domestic use. The heat exchanger design is found to be critical to the technical and economic performance of the system.

OTHER

REFER ALSO TO CITATION(S) 8337

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 8315, 8358, 8359, 8360, 8771, 8865

8363 (ALO—4122-T1) **Study and analysis of a low cost cement bonded flat plate solar collector. Final report.** (Mega Engineering

Div., Silver Spring, MD (USA)). Jan 1979. Contract EG-77-C-04-4122. 136p. Dep. NTIS, PC A07/MF A01.

The objective of this project was to conduct basic engineering and development leading to the design and construction of a low-cost, high-temperature liquid flat plate collector. A flat plate collector was designed and tested using low cost materials. This collector absorber plate included copper circulating tubes bonded to a flat sheet of conductive material using high service temperature, low outgassing, high conductivity adhesives. The engineering research phase of the project evaluated and thermally tested a series of candidate adhesives. Structural and thermal tests were performed using galvanized sheet steel collector plates and aluminum collector plates with copper tubes to evaluate the conductivity of bond joints. The structural integrity of bond joints was evaluated under relative thermal expansion forces at various temperatures (ranging from -35°C to 300°C). Thermal-cycling tests were conducted to evaluate fatigue of bond joints and to evaluate the degradation of thermal conductivity of these bond joints. During the development and evaluation phase of the project 128 square feet of flat plate collectors were constructed and tested. One insulated hot water storage tank was used for the system's thermal evaluation and installation cost evaluations. Finally, a cost/performance summary was made (using F-chart) to determine the potential cost savings realized compared with conventional systems.

8364 (ALO—4147-T1) **Non-concentrating collectors for solar heating applications (medium temperature air heaters based on durable transparent films). Final report, September 30, 1977-October 31, 1978.** Leffingwell, J.W.; Schwendeman, J.L.; Ball, G.L. III; Orofino, T.A. (Monsanto Research Corp., Dayton, OH (USA). Dayton Lab.). Mar 1979. Contract EG-77-C-04-4147. 143p. (MRC-DA—867). Dep. NTIS, PC A07/MF A01.

A special uv-stabilized and scrim-reinforced flexible (PVC) film was developed, characterized, and tested on an air solar heater according to ASHRAE 93. Solar energy transmission of early pre-contract 20-mil thick film was determined to be about 83% after two months outdoor Florida exposure, dropping to 78% after two years. Outdoor exposure and artificial uv aging tests indicate that a 10-year lifetime could be possible. The fabricated solar heater had a lower efficiency than predicted from computer modeling (43% for 129°F output with 62°F temperature rise at an ambient temperature of 60°F) suggesting design problems which could most easily be overcome by changing from a double-glazed non-selective absorber collector to a single-glazed-selective absorber heater.

8365 (ALO—4196-T1) **Dual curvature acoustically damped concentrating collector. Semiannual technical progress report, June 1-December 1, 1978.** (Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center). Dec 1978. Contract EM-78-C-04-4196. 116p. Dep. NTIS, PC A06/MF A01.

The project's first objective is to establish, analytically, the cost and performance of design choices within the boundaries of the basic proposed concept. With these cost and performance measures as a guide, the second project objective is to design a cost-effective Dual Curvature collector module and collector field array. The third objective is to establish technical and economic concept feasibility through prototype fabrication and test. The final objective is to define the Dual Curvature collector commercialization requirements. The Dual Curvature collector uses a unique reflector module consisting of a reflective film that is tensioned on a reflector support frame. The tensioned membrane (film) surface approximates a hyperbolic paraboloid that is capable of linear focusing when the surface tracks the sun's apparent motion in one axis. The reflective film can be backed by polystyrene foam with an air space between the film and the foam surfaces. This provides damping of the reflector surface to minimize the effect of wind gusts and physical impacts. The baseline collector is intended to operate at a concentration of ten (10) or greater with a nominal absorber temperature of 150°C (300°F). The Component Research and Analysis tasks which lead to the selection of a baseline collector configuration are discussed. Also, some preliminary results of the Collector Module Design task are presented.

8366 (ALO—4227-12) **Low-cost mirror concentrator based on double-walled metallized, tubular films. Second semiannual technical progress report, August 20, 1978-February 19, 1979.** Leffingwell, J.W.; Ball, G.L. III; Schwendeman, J.L.; Orofino, T.A. (Monsanto Research Corp., Dayton, OH (USA). Dayton Lab.). 30 Mar 1979. Contract EM-78-C-04-4227. 44p. Dep. NTIS, PC A03/MF A01.

A potentially, low cost, air inflatable, tubular plastic, non-tracking 3X solar collector is being developed. The design employs joined truncated cylindrical sections which reduce both cover and mirror material requirements by 40% compared with a conventional cylindrical design. Aluminum foil-plastic laminates have been selected as an alternative to aluminized polyester films because of their low cost, ease of fabrication, good durability, high strength, and acceptable reflectivity. Specially uv-stabilized and polyester scrim reinforced flexible polyvinyl chloride film has been selected for use as the outer transparent cover material because of its mechanical and optical durability, acceptable transmission characteristics and its potential low cost. At the completion of the first year of effort the materials for the concentrator have been selected and an improved material-efficient design has been proposed. These should provide the basis for a successful completion of the development during the second year of the program. Recommendations to accomplish this development are made.

8367 (ALO—4287-T1) **Selective paint and black chrome coatings development. Semiannual report, June 5-December 5, 1978.** Lin, R.J.H.; Zimmer, P.B. (Honeywell, Inc., Minneapolis, MN (USA). Systems and Research Center). Dec 1978. Contract EM-78-C-04-4287. 60p. Dep. NTIS, PC A04/MF A01.

Solar selective black chrome and paint coatings were investigated to improve their performance and to develop techniques for large-scale applications. Formulations and processing conditions for thickness sensitive paint coatings were defined which consistently provide solar absorptance (α) of 0.90 and emittance (ϵ) of 0.10 on low emittance substrates. A significant improvement in abrasion resistance was achieved by decreasing the pigment volume concentration. Addition of aluminum flake to these formulations has resulted in a thickness insensitive coating with $\alpha = 0.90$ and $\epsilon = 0.30$. The critical bath components of a commercial black chrome plating process have been identified as hexavalent chromium, trivalent chromium, acetic acid and ferric ion. These components were varied and their effect on coating optical properties and durability at temperatures of 350-400°C were studied. Coating thermal stability was significantly improved by reducing the trivalent chromium concentration from the normal 16 g/l to 12 g/l or less. Initial efforts have begun to optimize black chrome systems on aluminum substrates in terms of cost and durability.

8368 (ALO—4295-T1) **Development of improved insulation materials. Semiannual report, September 1, 1978-February 28, 1979.** Spells, S.; Homan, G.R.; Lee, C.L. (Dow Corning Corp., Midland, MI (USA)). 8 May 1979. Contract EM-78-C-04-4295. 33p. Dep. NTIS, PC A03/MF A01.

The laboratory development of an improved insulation material has led to the development of three types of low density silicone foam (Type IA, IB and II) and a composite foam (Type IA silicone foam/rigid polyurethane foam) that could be used in a flat plate solar collector. Type IA and IB foam are both crosslinked with SiOSi bond, the former being cured at room temperature using a platinum catalyst, whereas the latter being cured at 150°C using a rhodium catalyst. Type II foam is a room temperature vulcanized foam, crosslinked with $NCOS(CH_2)_3Si$ linkage. The density of Type IA and II foam has been reduced down to 2-3 lbs/ft^3 range whereas the lowest density of Type IB attained was 6 lbs/ft^3. Both IA and II low density silicone foam have a thermal insulation property comparable to those of commercially available insulation materials. TGA show that both Type IA and Type II foams gives only 1 to 2% weight loss at 200°C. At higher temperature, however, Type IA foam shows less weight loss than Type II foam. A composite foam, where Type IA foam was used to protect a thermally less stable rigid polyurethane foam, was evaluated and found to be an effective insulation material for a flat plate solar collector.

8369 (ALO—5300-T1) **Low-cost solar antireflection coatings. Semiannual report, July 24, 1978-January 24, 1979.** Lin, R.J.H.; Lee, J.C.; Zimmer, P.B. (Honeywell, Inc., Minneapolis, MN (USA). Systems and Research Center). Feb 1979. Contract EM-78-C-04-5300. 55p. Dep. NTIS, PC A04/MF A01.

Production processes for low-cost organic antireflection (AR) coating and etched AR coating on glass for flat plate collector covers are being developed and improved. The etched AR coating process has been scaled-up to etch full-size glass panes but the chemical control of the etching solution remains a problem. Analytical methods including high performance liquid chromatography, flame exited atomic absorption and infrared spectroscopy, have been investigated as possible monitoring and control devices. Liquid chromatography appears to give some useful information. An investigation of another technique, utilizing the differential refractive index of the etching solution, has just begun. The organic coating, FEP-120 Teflon dispersion, has been shown to be somewhat unstable and efforts are underway to improve the stability of the dispersion. A pretreatment of the glass substrate in hydrofluoric acid substantially improves the abrasion resistance of the coated glass. Further development will optimize this effect. Methods of maintaining thickness control during the coating of full size panels will be determined.

8370 (DOE/CS/35306—T1) **Development of selective surfaces. Semiannual technical progress report, September 11, 1978-April 30, 1979.** Thornton, J.A. (TELIC Corp., Santa Monica, CA (USA)). 15 Jun 1979. Contract AC04-78CS35306. 59p. Dep. NTIS, PC A04/MF A01.

Magnetron sputtering technology, which permits coatings to be deposited over large areas with significantly increased deposition rates, is reviewed with particular emphasis on cylindrical magnetrons and their application to reactive sputtering. Work is reported

in which cylindrical-post magnetron sputtering sources have been used to deposit both graded and multi-layered cermet-type coatings by sputtering chromium and type 304 stainless steel in Ar and O_2 and Ar and CO gas mixtures under various conditions of reactive gas injection. The substrates are aluminum-coated glass and aluminum foil. The coatings are of an interference type, typically about 100 nm thick, with a metal-rich, highly absorbing layer adjacent to the substrate and a dielectric material at the surface. In some cases a reactively sputtered aluminum oxide anti-reflective surface layer has also been used. No advantages have been found for using chromium as opposed to the more readily available stainless steel. The reactive sputtering with CO is attractive because under many conditions the sputtering rates are relatively large compared to oxygen. Hemispherical absorptance and emittance data are reported. Typical absorptances are about 0.90 with emittances of 0.10.

8371 (DOE/NASA/CR—161189) **Results of thermal performance evaluation of the Owens-Illinois Sunpak liquid solar collector at indoor conditions.** (Wyle Labs., Huntsville, AL (USA). Solar Energy Systems Div.). 10 Oct 1979. Contract EX-76-A-29-1037. 29p. Dep. NTIS, PC A03/MF A01.

This report provides test results on the thermal performance of an Owens-Illinois Sunpak liquid, evacuated tube, solar collector under simulated conditions. The test was conducted using the Marshall Space Flight Center Solar Simulator in accordance with the test requirements specified in ASHRAE 93-77 (Method of Testing to Determine the Thermal Performance of Solar Collectors) and the procedures contained in MTCP-FA-SHAC-400 (Procedure for Operation of the MSFC Solar Simulator Facility). The tests were performed on a module used on the early demonstration projects. A current production module is undergoing tests with results to be in a subsequent report.

8372 (LBL—9324(Rev.)) **Metal foils for direct application of absorber coatings on solar collectors.** Lampert, C.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 19p. (CONF-791021—1(Rev.)). Dep. NTIS, PC A02/MF A01.

From 2. American Electroplaters Society symposium on coatings for solar collectors; St Louis, MO, USA (16 Oct 1979).

The basic materials and processing associated with the production of coated metal foils for solar collector absorber surfaces are discussed. Also covered are details of heavier metal strips for direct fabrication of solar collectors. Techniques including bonding methods and the use of adhesives are surveyed. Commercial solar foil manufacturers are covered, chiefly Berry Solar Products and Ergenics, along with the new research efforts in this area. In conclusion, advantages and disadvantages are outlined, with specific recommendations.

8373 (SAND—79-0190) **Method for calculating shadows cast by two-axis tracking solar collectors.** Linn, J.K.; Zimmerman, J.C. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 32p. Dep. NTIS, PC A03/MF A01.

A method is described that quickly calculates the shadows cast from two-axis tracking solar collectors onto adjacent collectors. The solar collectors can have either circular or rectangular apertures.

8374 (SAND—79-8181) **Preliminary design report: new ideas for heliostat reflector cleaning systems.** Schumacher, J.; Hansen, J.; Nevenzel, J. (Schumacher and Associates, Inc., Sacramento, CA (USA)). Dec 1979. Contract EY-76-C-04-0789. 135p. Dep. NTIS, PC A07/MF A01.

The feasibility of two new concepts for cleaning heliostat reflectors has been investigated in this program and the results are itemized. In addition, this phase of the program involved the design and construction of a reflectometer and wind tunnel and the performance of some dust accumulation studies, the results of which are also listed. (MOW)

8375 (SERI/TP—333-485) **Development of a solar thermal receiver for high temperature applications.** Bohn, M.; Bessler, G. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1979. Contract EG-77-C-01-4042. 7p. (CONF-791221—1). Dep. NTIS, PC A02/MF A01.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

A thermal receiver for point focus collectors is being constructed. Its design, which is based upon experience with a commercial receiver, employs the advantages of that receiver and improves some of its features. The new receiver uses as a buffer between the cavity surface and the heat transfer fluid a thermal mass, which with a very small temperature drop penalty smooths the flux distribution to eliminate hot spots. Maximum operating temperature range was extended from 620°C to 870°C and receiver efficiency was improved. The design of the receiver enables significant spillage flux at the receiver to be used. Thus, lower quality optics can be employed in applications not requiring very high temperatures. Design and construction features of the receiver are presented and the testing program is described.

8376 **Triangular duct solar panel.** Parker, B.F. (to Univ. of Kentucky). US Patent 4,171,694. 23 Oct 1979. Filed date 3 Jun 1977. 8p.

A solar panel suitable for panelized building construction as an integral part of a roof is described. The solar absorber plate of the panel consists of a thermally conductive sheet folded along a plurality of parallel lines to form sharp vees or corrugations. The folded solar absorber plate is attached to or formed as part of a flat sheet also with high thermal conductivity. The folded absorber plate with its vee-shaped corrugations in combination with the flat sheet form a plurality of contiguous triangular ducts through which the fluid to be heated flows. The fluid is in direct contact with the solar absorber plate and the flat thermally conductive plate which together form the triangular ducts. A pliable insulating board may be provided as a backing member to the triangular duct assembly, said insulating board serves as an elastic mounting means for the solar panel on a building roof or wall. The triangular ducts may be oriented in an East-West direction to maximize the number of reflections of solar radiation between the ducts. 8 claims.

8377 **Apparatus for the collection and conversion of solar energy.** Korr, A.L.; Walker, E.H.; Svihel, B.T. (to A.L. Korr Associates, Inc.). US Patent 4,159,629. 3 Jul 1979. Filed date 30 Mar 1977. 14p.

Solar energy is collected by an array of parallel trough-like reflectors of paraboloidal cross-section, and concentrated upon radiation-absorbent pipes positioned along the lines of focus of the reflectors. The array is mounted on a boat which floats on an irrigation pond of a farm and is rotated by a clock-like drive mechanism so as to follow or track the daily east-west motion of the sun, thereby maintaining the concentration of solar radiation upon the pipes. The flotation of the array by means of the boat permits the use of very low drive power for rotating it to track the sun, and also shields the underlying water from the air and sun so as to reduce evaporation thereof. A central column stabilizes the position of the boat with respect to lateral drift or angular tilt, while permitting vertical motion of the boat in response to changes in pond level, the array may therefor be protected from heavy wind by dropping the pond level so that the array is protected by the sidewalls of the pond at such times. A rotating joint arrangement permits circulation of a heat-absorbent fluid such as water (steam) between the radiation-absorbent pipes and a location adjacent the pond where the developed heat is utilized. 22 claims.

8378 **Enhanced solar energy options using earth-orbiting mirrors.** Gilbreath, W.P.; Billman, K.W.; Bowen, S.W. (NASA, Ames Res Cent, Moffett Field, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1528-1534(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A system of orbiting space reflectors is described, analyzed, and shown to provide economically nearly continuous insolation to preselected ground sites, producing benefits hitherto lacking in conventional solar farms and leading to large reductions in energy costs for such installations. Free-flying planar mirrors of about 1 km^2 are shown to be optimum and can be made at under 10 g/m^2 of surface, thus minimizing material needs and space transportation costs. Models are developed for both the design of such mirrors and for the analysis of expected ground insolation as a function of orbital parameters, time, and site location. Various applications (agricultural, solar-electric production, weather enhancement, etc.) are described.

8379 **Design, construction, and testing of a fixed mirror solar concentrator field.** Schuster, J.R.; Russell, J.L. Jr.; Eggers, G.H. (Gen At Co, San Diego, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1541-1547(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The Fixed Mirror Solar Concentrator (FMSC) employs a fixed mirror circular trough that produces a sharp line focus regardless of sun position. The heat receiver, which employs a compound parabolic (Winston) secondary concentrator, is moved in a circular arc to track the focal line. With secondary concentration the FMSC has a theoretical upper concentration limit of 206 suns, and the secondary concentrator makes possible the design of a practical FMSC to generate efficiently steam at modern steam plant operating conditions. Because the mirror trough of the FMSC is stationary, it can be made using low-cost type construction approaches. FMSC modules have been fabricated of precast concete and glass mirrors to supply a 260-m^2 collector field to Sandia Laboratories for their Solar Total Energy Demonstration Facility.

8380 **Thermal performance trade-offs for point focusing solar collectors.** Wen, L. (Calif Inst of Technol. JPL, Pasadena). *Proc.,*

Intersoc. Energy Convers. Eng. Conf.; **2**: 1548-1553(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Solar thermal conversion performance is assessed in this paper for representative point focusing distributed systems. Trade-off comparisons are made in terms of concentrator quality, solar receiver operating temperature, and power conversion efficiency. Normalized system performance is presented on a unit concentrator area basis for integrated annual electric energy production.

8381 **Measurement of heat loss from a heat receiver assembly of a fixed mirror solar concentrator.** Walker, W.E.; Housman, J.J.; Russell, J.L. (Gen At Co, San Diego, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1554-1562(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The paper reports on an experimental measurements program on a heat receiver of the type currently used by the Fixed Mirror Solar Concentrator (FMSC) at the Sandia Solar Total Energy Test Facility. The objective of the measurements was to obtain a reliable data base suitable for comparison with, and evaluation of, engineering design methods of heat loss from a class of linear solar heat receivers. The program defined a balanced data sampling matrix for the variables of temperature, wind condition, material property, and configuration; designed and constructed electrically heated thermal mock-ups of the heat receiver, a wind tunnel, and a data collection system; collected performance data and performed evaluation experiments to determine end effects, instrument stability and accuracy, and approach to equilibrium; compared the results with predictions of solar receiver heat loss computer models and with preliminary loss data available from the Sandia program.

8382 **Effects of pointing errors on receiver performance for parabolic dish solar concentrators.** Hughes, R.O. (Calif Inst of Technol, JPL, Pasadena). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1563-1569(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The effects of dynamic (moving) pointing errors on the performance of solar thermal receivers is investigated. Only point focusing types of solar collectors are considered. The key element in the study is the analytical derivation of the intercept factor that relates pointing errors to captured energy at the receiver. A detailed example using typical parameter values is modeled on the digital computer and demonstrates the theory and the dynamic nature of the problem.

8383 **Transient energy removal in cylindrical parabolic collector systems.** Wijeysundera, N.E. *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1570-1574(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

This paper describes two heat transfer models for the transient energy removal in cylindrical parabolic collectors. The models are used to study the transient behavior of cylindrical parabolic collectors and their respective accuracies of prediction are compared. A single design parameter, namely the collector time constant is used to characterize the transient behavior. The dependence of this time constant on other collector design variables is studied using the heat transfer models.

8384 **Hybrid air to water solar collector design.** Loth, J.L.; Palmer, G.M. (WVa Univ, Morgantown). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1608-1613(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A large, inexpensive, lightweight grooved Foamglas solar collector assembly has been designed and installed. Six different collector construction techniques are applied. The six types are connected in parallel to allow independent thermal performance testing. An automated data logger collects performance data from all six types of collectors simultaneously and at preselected intervals. All collectors discharge the hot air to a single header. The air is then ducted through a blower, several electric heater elements and then through three "A" coils. Water is pumped through these air conditioning evaporator "A" coils to obtain domestic hot water heating. The test objectives are to determine the most cost effective area ratio between the solar collectors and that of the "A" coils, and the total hybrid system thermal performance.

HEAT STORAGE

REFER ALSO TO CITATION(S) 8314

8385 (SAND—79-8814) **Sandia Laboratories in-house activities in support of solar thermal large power applications.** Mar, R.W. (Sandia Labs., Livermore, CA (USA)). 1979. Contract EY-76-C-04-0789. 5p. Dep. NTIS, PC A02/MF A01.

Research activities have been planned and carried out in direct support of the development of thermal energy storage subsystems for solar thermal large power applications. The emphasis has been on characterizing the behavior of molten nitrate salts with regard to thermal decomposition, environmental interactions, and corrosion. The results to date and future activities are summarized.

8386 (TID—29430) **Solar applications of thermal energy storage. Final report.** Lee, C.; Taylor, L.; DeVries, J.; Heibein, S. (Hittman Associates, Inc., Columbia, MD (USA)). Jan 1979. Contract EM-78-C-01-4275. 158p. Dep. NTIS, PC A08/MF A01.

The objective of this study is to prepare a technology assessment on solar energy systems which use thermal energy storage. The study includes characterization of the current state-of-the-art of thermal energy storage, an assessment of the energy storage needs of solar energy systems, and the synthesis of this information into preliminary design criteria which would form the basis for detailed designs of thermal energy storage. Since the goal of the solar thermal energy storage program is to provide optimum storage units for solar thermal energy systems, this study has focused on storage concepts that are either commercially available or will be commercially available by 1979. (MOW)

GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 8727, 8728

RESOURCE STATUS AND ASSESSMENT

USA

8387 (LA-UR—79-3043) **Hot Dry Rock Geothermal Energy Development Program.** Franke, P.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 16p. (CONF-791204—3). Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

The overall objective of the Hot Dry Rock (HDR) Geothermal Energy Development Program is to determine the technical and economic feasibility of HDR as a significant energy source and to provide a basis for its timely commercial development. Principal operational tasks are those activities required to enable a decision to be made by FY86 on the ultimate commercialization of HDR. These include development and analysis of a 20- to 50-MW Phase II HDR reservoir at Site 1 (Fenton Hill) with the potential construction of a pilot electric generating station, Phase III; selection of a second site with subsequent reservoir development and possible construction of a direct heat utilization pilot plant of at least 30 MW thermal thereon; the determination of the overall domestic HDR energy potential; and the evaluation of 10 or more target prospect areas for future HDR plant development by commercial developers. Phase I of the Los Alamos Scientific Laboratory's Fenton Hill project was completed. Phase I evaluated a small subterranean system comprised of two boreholes connected at a depth of 3 km by hydraulic fracturing. A closed-loop surface system has been constructed and tests involving round-the-clock operation have yielded promising data on heat extraction, geofluid chemistry, flow impedance, and loss of water through the underground reservoir between the two holes, leading to cautions optimism for the future prospects of private-sector HDR power plants. (MHR)

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 9386, 9387, 9388, 9389, 9390, 9391, 9392, 9393, 9394, 9395

8388 (LBL—7053, pp 1-7) **Magnetotelluric observations at the Roosevelt Hot Springs KGRA and Mineral Mts., Utah.** Wannamaker, P. (Univ. of Utah, Salt Lake City). 1978.

From Workshop on modeling of Electrical and Electromagnetic methods; Berkeley, CA, USA (17 May 1978).

Twenty-five magnetotelluric soundings in the Roosevelt Hot Springs area indicate a very complicated, three-dimensional electrical environment. The assembly of a profile of one-dimensional, transverse electric interpretations yields a calculated 2-D apparent resistivity-frequency pseudosection far removed from the observed data. Trial-and-error modelling improves the fit only a little. The

most notable difficulty, the presence in both TE and TM pseudosections of pronounced contrasts in rho/sub a/ persisting to the lowest observed frequency, may be explained by the discontinuities in electric field that are found for all directions of wave excitation for 3-D geometries. The extimation of electrical strike is also difficult in the 3-D case since the total fields do not decompose into the two principal excitation modes. Whenever a plane of symmetry exists, the estimated electrical strike will be normal to it; otherwise an oblique estimation results. The observed consistency of strike estimation at Roosevelt is likely due to the gross, elongate, resistive horst-structure of the Mineral Mts. in surrounding conductive valley fill. Mode identification and the effects of near-surface 3-D inhomogeneities pose potential major limitations to the magnetotelluric method.

LEGAL AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 8390

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 8390, 8446

8389 (DOE/EDP—0036) **Environmental development plan: geothermal energy systems.** (Department of Energy, Washington, DC (USA)). Aug 1979. 77p. Dep. NTIS, PC A05/MF A01.

To ensure that environmental, health, and safety (EH and S) considerations are addressed adequately in the technology decision making process, the Environmental Development Plan (EDP) identifies and evaluates EH and S concerns; defines EH and S research and related assessments to examine or resolve the concerns; provides a coordinated schedule with the technology program for required EH and S research and developement; and indicates the timing for Environmental Assessments, Environmental Impact Statements, Environmental Readiness Documents, and Safety Analysis Reports. This EDP for geothermal energy systems covers all current and planned activities of the DOE Geothermal Energy Systems. Hydrothermal convection systems, geopressured systems, and hot-dry-rock systems are covered. Environmental concerns and requirements for resolution of these concerns are discussed at length. (MHR)

GEOTHERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 8437

8390 (UCID—18326) **History of prior federal action and NEPA documentation for NCPA Project No. 2.** Daniels, J.I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1979. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

The federal actions are documented that were performed to ensure environmental protection during the leasing, exploration, development and utilization of geothermal resources on those public lands of The Geysers KGRA in California associated with the proposed Northern California Power Agency (NCPA) Geothermal Project No. 2. Approval for development of these geothermal resources on public lands in The Geysers KGRA was preceded by extensive environmental analyses conducted over the past decade by the US Department of Interior, and its agencies. These analyses include the Environmental Impact Statement (EIS) for the Geothermal Leasing Program, an Environmental Analysis Record for the selected lease areas in The Geysers KGRA, and site specific Environmental Assessments. All of these documents were prepared to comply with policies, purposes, and goals of the National Environmental Policy Act (NEPA) of 1969 and pertinent state and local environmental protection standards. In addition, these documents contain the environmental protection stipulations which must be agreed to by Shell Oil Company (the geothermal steam provider) and NCPA (the electric power plant builder operator) before development and utilization can begin.

POWER PLANT SYSTEMS AND COMPONENTS

8391 **Performance of a 10 MW geothermal energy conversion test facility.** Jacobson, W.O. (San Diego Gas and Electr Co, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1074-1076(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The performance of San Diego Gas and Electric's Geothermal Loop Facility has been generally good. Comparison of initial flash/binary conversion cycle selection criteria to performance data has led to renewed interest in a flash cycle. Brine system performance has been generally successful but hampered by scale accumulation. Improved scale removal and control techniques are being evaluated. Geothermal steam and condensate systems have shown good steady state performance, but performance is adversely affected by upsets or oscillations. Operation of the binary system, originally designed for isobutane, with water as the working fluid has been off design, but no performance problems are expected if design conditions are approached.

8392 **Fossil superheating in geothermal steam power plants.** DiPippo, R.; Khalifa, H.E.; Correia, R.J.; Kestin, J. (Brown Univ, Providence, RI). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1095-1101(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The results are reported of thermodynamic studies of geothermal steam power systems incorporating fossil-fired superheaters. One- and two-stage systems are covered. Realistic assumptions have been included to account for losses that may be incurred in actual plants. The systems are evaluated on the basis of a number of appropriate figures of merit. It is found that fossil superheat hybrid geothermal power plants offer a thermodynamic advantage over individual fossil and geothermal plants for a wide range of operating conditions, and deserve consideration whenever fossil and geothermal energy resources are found in reasonable proximity.

8393 **Hydrocarbon working fluid and operating conditions selection for the conventional geothermal binary cycle.** Iqbal, K.Z.; West, H.H.; Starling, K.E. (Univ of Okla, Norman). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1114-1120(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

To examine a wide variety of potential working fluids, a fluid screening procedure was developed. The first phase of the three phase screening procedure permits a quick evaluation, with potential working fluids identified for more detailed analysis. The second phase screening procedure requires more thermophysical property data for the potential working fluid in order to evaluate a series of cycle parameters. The final phase of the screening procedure requires evaluation with the aid of a power cycle simulation program complete the rigorous thermodynamics, process, and economic estimation routines. The working fluids compared in detail herein include isobutane, isopentane, cis-2-butene, R-11, R-114 and an equimolar mixture of isobutane and isopentane. It is concluded that the range of working fluids considered by the industry to date has been too limited.

GEOTHERMAL ENGINEERING

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 8887, 8927

8394 (UCRL—83122) **Processing of high salinity brines for subsurface injection.** Thompson, R.E.; Raber, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Aug 1979. Contract W-7405-ENG-48. 6p. (CONF-800102—1). Dep. NTIS, PC A02/MF A01.

From International conference on geotechnical and environmental aspects of geopressure energy; Sea Island, GA, USA (13 Jan 1980).

Different chemical pretreatments and filtration methods were evaluated as a possible means of clarifying and improving the injectivity of hypersaline brines. Six different downflow media combinations were evaluated over three geopressurized sites, using test data from 4 inch diameter filters. Also, tests were conducted with one hollow fiber ultrafilter unit and two types of disposable cartridge filters. The test procedures are mentioned briefly. (MHR)

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

8395 (LA—7963) **Thermal fracture effects in geothermal energy extraction.** Demuth, R.B.; Harlow, F.H. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 148p. Dep. NTIS, PC A07/MF A01.

Heat and water exchange between the primary crack and a lateral thermal fracture are analyzed by means of numerical modeling on a high-speed computer. Three-dimensional heat flow in the rock is coupled to a two-dimensional approximation for the time-varying convective patterns that result from both forced flow and buoyancy. The physical and mathematical bases for the study are described together with the numerical technique for solution. The report includes listing of three versions of the computer code and some results of representative calculations.

8396 (LA-UR—79-3256) **Energy from hot dry rock.** Hendron, R.H. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 22p. (CONF-791216—1). Dep. NTIS, PC A02/MF A01.

From Conference on long-term energy resources; Montreal, Canada (3 Dec 1979).

The Hot Dry Rock Geothermal Energy Program is described. The system, operation, results, development program, environmental implications, resource, economics, and future plans are discussed. (MHR)

DIRECT ENERGY UTILIZATION

8397 **Heat transfer consideration in utilizing solar and geothermal energy.** Michel, J.W. (Oak Ridge Natl Lab, Tenn). pp 2801-2825 of Alternative energy sources. Vol. 6. Veziroglu, T.N. (ed.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

Although some forms of solar and geothermal energy will require the application of high temperature technology, most involve only low temperatures. This paper emphasizes the importance of efficient, low cost heat exchangers in the use of low temperature sources and in the waste heat rejection systems of power generation cycles. Results of recent heat transfer development work at ORNL show that for the working fluids which are attractive for use in these cycles the condensation heat transfer effectiveness can be improved by a factor of from 3 to 7 by the use of fluted densation of six fluorocarbons, isobutane, and ammonia on a variety of tube surfaces. These results are being applied to the design of a 40-tube heat exchanger to be tested in a geothermal energy test facility.

GEOTHERMAL DATA AND THEORY

8398 (RLO—1830-T3) **Detailed conceptual design of a high temperature glass pH electrode for geothermal applications. Final report, Task I.** Gray, D.N.; Breno, P.J. (Owens-Illinois, Inc., Toledo, OH (USA). Corporate Technology Div.). May 1979. Contract EY-76-C-06-1830. 57p. Dep. NTIS, PC A04/MF A01.

A modification of the planar electrode technology yielded prototype glass pH electrodes that can withstand the minimum test conditions of 250°C and 5000 psi in an aqueous synthetic geothermal brine. Electrodes of this design can be made in volume at reasonable cost. In addition, an electrode holder has been designed and prototypes fabricated to permit laboratory testing in simulated geothermal brines of downhole conditions.

PROPERTIES OF AQUEOUS SOLUTIONS

8399 (LBL—9621) **Aqueous solutions database to high temperatures and pressures: NaCl solutions.** Phillips, S.L.; Otto, R.J.; Ozbek, H.; Tavana, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 30p. (CONF-790896—1). Dep. NTIS, PC A03/MF A01.

From Workshop on techniques for measurement of thermodynamic properties; Albany, OR, USA (21 Aug 1979).

A survey is made of available experimental data on sodium chloride solutions which are used in geothermal energy exploration and development for electrical power production and direct use. The data are classified as thermodynamic, transport and physical; they are useful in the design and development of a geothermal area from brine production through utilization, to brine disposal. An ideal data system for geothermal energy is described.

WIND ENERGY

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 8234

8400 (CONF-790352—, pp 83-93) **Wind resource assessment status.** Wendell, L.L. (Battelle Pacific Northwest Lab., Richland, WA). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

An assessment of wind power as an energy resource in the US is presented.

8401 (SERI/TR—35-078(Vol.2)) **Conversion system overview assessment. Volume II. Solar-wind hybrid systems.** Jayadev, T.S.; Henderson, J.; Bingham, C. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1979. Contract EG-77-C-01-4042. 34p. Dep. NTIS, PC A03/MF A01.

Solar-wind hybrid systems are discussed. It is shown that there are large areas in the United States where solar and wind resources are comparable in magnitude and there are diurnal and seasonal complementarities which offer the potential for cost-effective hybrid systems. There are also distinct engineering features of the two conversion technologies. Electric power generation from wind is straightforward and cost-effective, whereas solar thermal conversion to generate heat is more cost-effective than to generate electricity. Examples of hybrid systems utilizing these features in total energy applications are presented.

REGULATIONS

8402 (SERI-TP—354-466) **Product liability insurance for WECS.** Noun, R.J. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1979. Contract EG-77-C-01-4042. 6p. (CONF-791097—2). Dep. NTIS, PC A02/MF A01.

From 4. biennial conference and workshop on wind energy conversion systems; Washington, DC, USA (28 Oct 1979).

Preliminary findings from a sampling of manufacturers indicate that product liability insurance for WECS is still difficult to obtain in many cases. About half of the 21 WECS manufacturers contacted do not have product liability insurance at this time. About one manufacturer in three who has attempted to obtain insurance has been rejected by at least one insurance company. In some instances, although an insurer had offered to provide coverage, the manufacturer found the rates quoted to be prohibitively expensive.

ECONOMICS

REFER ALSO TO CITATION(S) 8401, 8412

8403 (CONF-790352—, pp 73-81) **Economic overview of Vertical Axis Wind Turbines.** Sullivan, W.N. (Sandia Labs., Albuquerque, NM). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

Sandia Laboratories, as part of its investigation of the Darrieus Vertical Axis Wind Turbine (VAWT), has been involved recently in an economic assessment of the concept. The class of VAWT's investigated used curved, fixed-pitch blades of constant section rigidly attached to a vertical rotating tower. Qualitatively, the main advantages of the VAWT over more conventional, propeller-type machines are the elimination of yaw controls, the placement of mechanical equipment at ground level, its amenability to simple, low-cost blade fabrication techniques, and aerodynamic stall characteristics which eliminate the need for active pitch control devices. The main disadvantages relative to modern propeller machines are a somewhat lower aerodynamic efficiency (about 10% lower), the limited ability of the rotor to self-start, and generally lower rotor operating rpm's, which leads to higher torque capacity requirements for the drive train.

8404 (CONF-790352—, pp 110-124) **Requirements assessment of wind power plants in electric utility systems.** Marsh, W.D. (General Electric Co., Schenectady, NY). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

A brief report is presented for the procedures and results of a study performed by the Electric Utility Systems Engineering Department of the General Electric Company for the Electric Power Research Institute under Contract RP740-1. The major objective was to develop a methodology for studying the performance and economic requirements of wind plants when applied to electric utility power systems. The methodology was then exercised in several actual utility systems to confirm and demonstrate its capability. This study has demonstrated that established utility generation planning methods can successfully be adapted to the study of wind power plants. The proper criterion for comparison of generating units is total utility system costs, recognizing unit operating flexibility.

8405 (CONF-790352—, pp 127-154) **Wind energy systems application to regional utilities.** Johanson, E.E.; Goldenblatt, M.K. (JBF Scientific Corp., Wilmington, MA). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

The prime thrust of the work was to develop a generic planning process that any utility could use to determine the feasibil-

ity of utilizing WECS as part of their future mix of equipment. While this is primarily an economic process, other questions dealing with WECS availability, capacity credit, operating reserve, performance of WECS arrays, etc., had to be addressed. Since the mature product cost of WECS is uncertain at this time, the approach used was to establish the worth, or value, of WECS by adding them to the utility mix at zero cost and determining what savings the utility would realize from its conventional sources, due to the presence of the WECS. These savings could then be used to establish what the utility could pay for the WECS, and break even.

8406 (CONF-790352—, pp 158-169) **Wind energy central station power generation in the Southwest and Southeast.** Guild, D.H. (Stone & Webster Engineering Corp., Boston, MA). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

The information presented is abstracted from two much broader studies. The first study to be referenced forms the basis for most of the information to be presented and is entitled, "The Southwest Project." This study was undertaken by Stone & Webster, a state power authority and 12 electric utilities in the Southwest to investigate ways to accelerate the commercialization of solar electric generating plants and their expected market penetration into the electric utility network of the southwestern United States through the year 2000. The Southeast Regional Assessment Study, like the Southwest Project, focused on solar electric power generation. It was different from the Southwest Study, however, in that contractural requirements placed equal emphasis on central station and on-site power generation. The stated objective of the Southeast Study was to identify and evaluate opportunities for demonstration and large scale deployment of solar electric central stations and on-site solar electric facilities through the year 2000.

8407 (CONF-790352—, pp 171-187) **Electric utility application of WECS in an island location.** Lindley, C.A. (Aerospace Corp., El Segundo, CA). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

The results reported were obtained as part of a DOE Wind Office contract study intended to assess the potential of Wind Energy Conversion Systems (WECS) for application on Oahu. The DOE results were intended to be very general, as a guide to DOE's future design and application planning for WECS. The study was supported by subcontracts with the University of Hawaii (UoH) and the Hawaiian Electric Company (HECO), and by uncontracted assistance from the Hawaii Department of Planning and Economic Development (DPED), all of whom provided significant input data and background.

8408 (CONF-790352—, pp 190-203) **Wind/hydro generation assessment.** Watts, A.W. (Bureau of Reclamation, Denver, CO). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems: Monterey, CA, USA (26 Mar 1979).

The Bureau of Reclamation is currently involved in a special 3-year study of the feasibility to integrate wind turbine generators with an existing Federal hydroelectric system. Reclamation's interest is in implementation of the wind turbine technology and not the research and development of the hardware. The study started in October 1977 and is designed to: test the concept of integrating wind and hydroelectric generation facilities for production of wholesale power; determine the environmental impacts of wind generation within the study area; evaluate the feasibility and justification for constructing a large-scale wind farm; and measure the acceptance and reaction of the public to the plan.

8409 (CONF-790352—, pp 205-214) **Distributed wind generation assessment.** Oplinger, J.L. (General Electric Co., Schenectady, NY). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

The overall objective of this project is to develop a methodology for utility evaluation of distributed wind power systems in their respective service areas. The methodology will allow comparison of distributed wind power systems with central station wind plants and conventional central station generation, as well as with other types of distributed generation. Site specific analyses will be performed on three utility systems to assess impacts of distributed wind power plants on utility systems. Preferred distributed wind power systems will be selected based on the site specific analyses. The preferred distributed wind power systems will form the basis for an impacts and penetration analysis. The impacts to be evaluated are both those which directly affect utility operations or costs and those which are experienced indirectly as, for example, through community response to proposed installations.

ENVIRONMENTAL ASPECTS

8410 (CONF-790352—, pp 95-108) **Environmental issues assessment.** Kornreich, T.R.; Kottler, R.J. Jr. (JBF Scientific Corp., Arlington, VA). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

The development and commercialization of wind turbine systems present a number of environmental problems that must be solved before widespread implementation of these systems can occur. The major areas that have been investigated include: interference with electromagnetic transmissions (air navigation systems, microwave communications links, radio and television broadcasts); sound intensity; safety; siting problems; ecological concerns; public acceptance; and legal and institutional issues. Each of these potential problem areas is discussed. The completed and active research projects in each area are identified. An overview of the current status of environmental barriers to the commercialization of large scale wind turbine systems is presented.

WIND ENERGY ENGINEERING

REFER ALSO TO CITATION(S) 8585, 8592, 8593, 8595

APPLICATIONS

8411 **Advanced wind furnace systems for residential and agricultural heating and electrical supply applications.** McGowan, J.G.; Sarkisian, P.H. (Univ of Mass, Amherst). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 2074-2081(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

This paper summarizes the results of an analytical performance and economic evaluation of three advanced wind furnace heating systems. The work represents an extension of previous work on wind powered heating systems and extends this wind energy application to the supply of electricity as well as space and hot water energy loads for rural residences and farms. Details of the proposed systems and the analytical modeling of the overall system and subcomponents are presented, as well as typical system energy and economic performance.

TURBINE DESIGN AND OPERATION

8412 (CONF-790352—) **Proceedings of the workshop on economic and operational requirements and status of large scale wind systems.** Clark, E.F.; de Winter, F. (eds.). (Altas Corp., Santa Cruz, CA (USA); JBF Scientific Corp., Arlington, VA (USA)). Jun 1979. 463p. Dep. NTIS, PC A20/MF A01.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

Papers are presented concerning wind energy technology; wind generation value in electric utility systems; large wind turbine generator operation and status; and network interaction analyses.

8413 (CONF-790352—, pp 3-43) **Overview: Department of Energy Wind Energy Program.** Ancona, D.F. (Dept. of Energy, Washington, DC). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

The Department of Energy Federal Wind Program is described for both large turbines and small innovative concepts. Budget information is also included.

8414 (CONF-790352—, pp 44-49) **EPRI wind energy activities.** DeMeo, E.A. (Electric Power Research Inst., Palo Alto, CA). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

The EPRI wind energy program is described concerning the identifying and assessing of prospective roles for wind generation in electric utility systems and the assessing of requirements that utility operation will place on wind hardware.

8415 (CONF-790352—, pp 50-70) **Large horizontal axis wind turbine development.** Robbins, W.H.; Thomas, R.L. (NASA Lewis Research Center, Cleveland, OH). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

One facet of the Federal Wind Energy Program, Large Horizontal Axis Wind Turbine Development, is being managed by

the NASA Lewis Research Center. These activities consist of several on-going wind system developments oriented primarily toward utility application. In addition, a comprehensive technology program, which supports the wind turbine projects, is being conducted. This paper presents an overview of the NASA activities.

8416 (CONF-790352—, pp 215-245) **Utility operational experience on the NASA/DOE Mod-OA 200 kW wind turbine.** Glasgow, J.C.; Robbins, W.H. (NASA Lewis Research Center, Cleveland, OH). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

The Mod-OA 200 kW Wind Turbine was designed and fabricated by the Lewis Research Center of the NASA under the direction of the US Department of Energy. The project is a part of the Federal Wind Energy Program and is designed to obtain early wind turbine operation and performance data while gaining initial experience in the operation of large, horizontal axis wind turbines in typical utility environments. On March 6, 1978 the Mod-OA wind turbine was turned over to the Town of Clayton Light and Water Plant, Clayton, NM, for utility operation and on December 31, 1978, the machine had completed ten months of utility operation. This paper describes the machine and documents the recent operational experience at Clayton, NM.

8417 (CONF-790352—, pp 248-282) **MOD-1 Wind Turbine Generator Program status report.** Poor, R.H. (General Electric Co., Philadelphia, PA). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

The MOD-1 WTG is the first megawatt class machine in the national wind program. The MOD-1 Program which started in September 1976, has as its objectives the design, fabrication, installation, and test of a two megawatt wind turbine generator (WTG) which generates utility grade electrical power. The program requirements and goals are shown. WTG assembly, factory test and installation at Howard's Knob, Boone, NC are described.

8418 (CONF-790352—, pp 283-296) **Cuttyhunk Island installation WTG Energy Systems, Inc. MP1-200 control system design.** Rose, M. (WTG Energy Systems, Inc., Angola, NY). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

A control system for a wind generator must satisfy many requirements if it is to be interconnected to a utility network. It should be fully automatic in operation and contain the necessary logic for stable and accurate control of the generator's frequency, power, voltage and VAR output. In addition it should provide the necessary protection for the system in the event of a component failure. A system for controlling the speed of a wind generator has been developed by WTG Energy Systems, Inc. which utilizes load modulation with a fixed pitch rotor configuration. The MP1-200 wind turbine (Figure 1) pictured on Cuttyhunk Island, Massachusetts utilizes a three bladed, 80 feet in diameter rotor operating upwind of the tower. The machine is constructed entirely of steel. The tower height, measured from ground level to the rotor's center line, is 80 feet. The rotor operates at a constant 30 rpm driving a 250 KVA synchronous generator through a 40:1 transmission. Blade tips rotate 60 degrees out of plane to provide aerodynamic braking. A 24 inch disc brake mounted on the high speed shaft is used for parking the rotor.

8419 (CONF-790352—, pp 297-309) **Fully interconnected wind system.** Frederick, W.A.; Miller, J.A.; Pfluger, J.E. (Pennsylvania Power & Light Co., Allentown). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

In November of 1977 the Pennsylvania Power & Light Company decided to install a wind turbine generator (WTG) that had a full three phase connection to the electrical distribution system. Energy Development Company was in the process of installing two machines just west of Allentown (Dorney Park). Their ready availability and simple design made them a natural supplier for the PP & L project. The machine chosen for installation was EDC's Model 445, a 45 kW, four-bladed machine with 45-foot-diameter rotor and 40-foot tower. The generator was three phase ac. The unit has a brake that can be operated manually or automatically; in the latter mode it will shut the machine down at 35 mph. The unit is designed to survive gusts of up to 120 mph. The installation was supervised by T. Mehrkam, Energy Development Company, 179E RD No. 2, Hamburg, Pennsylvania 19526.

8420 (CONF-790352—, pp 312-315) **Status of the Southern California Edison Company 3 MW wind turbine generator (WTG) demonstration project.** Scheffler, R.L. (Southern California Edison Co., Rosemead). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

To demonstrate the concept of utility scale electricity production from a high wind energy resource, Southern California Edison Company (SCE) has initiated a program to construct and test a 3 megawatt (3,000 kilowatt) Schachle Wind Turbine Generator (WTG) at a SCE-owned site near Palm Springs, California. The background and current status of this program are presented along with a summary of future planned program activities.

8421 (CONF-790352—, pp 318-331) **MOD-2 wind turbine.** Lowe, J.E.; Engle, W.W. (Boeing Engineering and Construction Co., Seattle, WA). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

A description is presented of the development of the MOD-2 wind turbine system, and the outlook for its future commercial application is discussed.

8422 (CONF-790352—, pp 334-351) **Magdalen Islands VAWT field test.** South, P. (National Research Council of Canada, Ottawa, Ontario); Watts, A. Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

An experimental VAWT has been installed on the Magdalen Islands as a joint Hydro-Quebec-NRC venture. The rotor is 37 m high by 24 m diameter and drives a 224 kW induction generator which is connected to the islands' electrical distribution grid. The turbine has been operated at up to approximately 80% of design rpm. Some results of performance measurements at this speed are given. The results indicate that the turbine performance is satisfactory and that it should produce its full rated power. The turbine rotor was destroyed in an accident and the turbine is undergoing extensive repairs.

8423 (CONF-790352—, pp 353-365) **Summary report on the collapse of the Magdalen Islands wind turbine.** Templin, R.J. (National Research Council of Canada, Ottawa, Ontario); McConnell, R.D. Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

On the morning of 6 July 1978, Hydro-Quebec personnel arrived at the site of the Magdalen Island 230 kW vertical axis wind turbine. The turbine was found turning, unattended, at about 30 rpm. The main disc brake was no longer connected to the rotor's drive train and the spoilers were working intermittently. Close to 9:30 am (local time) the spoilers closed completely and the turbine began an hour of running at 60 rpm to 70 rpm. The turbine eventually sped up to about 74 rpm, the evident location of a mechanical resonance, and turbine blades began striking the rotor's support cables. Finally, a cable turnbuckle broke and at 10:19 (local time) the turbine rotor broke off and fell to the ground. Analysis of the turbine failure is presented.

8424 (CONF-790352—, pp 378-387) **Impact of storm fronts on utilities with WECS arrays.** Schlueter, R.A.; Park, G.L.; Modir, H.; Dorsey, J.; Lotfallian, M. (Michigan State Univ., East Lansing). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

The objectives of this DOE sponsored research project are to determine the impact of significant changes in WECS generation on AGC regulation, economic dispatch, and governor frequency regulation; and to determine solutions for such operating problems caused by WECS generation changes. An AGC saturation problem and a resultant violation of NAPSIC performance requirements were shown to occur for large simultaneous storm induced WECS generation change and load change. This problem is alleviated if spinning reserve margins are increased. An improvement in response to WECS generation changes is shown to be possible by including a higher percentage of faster responding units. Finally a cycling phenomena was shown to occur on nuclear units if the generation changes on echelons is great enough to cause frequency deviations that exceed governor deadband on the unit in question.

8425 (CONF-790352—, pp 388-402) **Lewis Research Center studies of multiple large wind turbine generators on a utility network.** Gilbert, L.J. (NASA-Lewis Research Center, Cleveland, OH); Triezenberg, D.M. Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

The Wind Energy Project Office of NASA-Lewis has undertaken a multi-faceted program to study the anticipated performance of a wind turbine generator farm on an electric utility network. Both in-house and contractor resources are being used. Preliminary results of an in-house simulation of two Mod-2 systems tied to an infinite bus indicate favorable system performance.

8426 (CONF-790352—, pp 403-413) **Field experience with wind turbine generator operation in utility systems.** Reddoch, T.W. (Univ. of Tennessee, Knoxville). Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

A vital part of the development of wind technology is the successful integration of it into electrical power systems. In order to achieve this objective, the Federal Wind Energy Program has chosen seventeen candidate sites for field test studies, three of which will be discussed in this report. The sites are Clayton, New Mexico; Culebra, Puerto Rico; and Block Island, Rhode Island. Each site receives a DOE/NASA Mod O-A which is rated at 200 kW in a 22.4 mph wind at the 30 meter height. The characteristics of each site are sufficiently different such that the sum total of information provided by the sites will yield vital data for basic integration requirements.

8427 **Design and operating experience on the US Department of Energy experimental Mod-O 100 kW wind turbine.** Glasgow, J.C.; Birchenough, A.G. (NASA, Lewis Res Cent, Cleveland, Ohio). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 2052-2059(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The turbine was designed and fabricated by NASA, as part of the Federal Wind Energy Program, to assess technology requirements and engineering problems of large wind turbines. The machine became operational in October 1975 and has demonstrated successful operation in all of its design modes. During the course of its operations the machine has generated a wealth of experimental data and has served as a prototype developmental test bed for the Mod-OA operational wind turbines which are currently used on utility networks. This paper describes the mechanical and control systems as they evolved in operational tests and describes some of the experience with various systems in the downwind rotor configuration.

8428 **Experimental demonstration of the Diffuser Augmented Wind Turbine concept.** Gilbert, B.L.; Foreman, K.M. (Grumman Aerosp Corp, Bethpage, NY). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 2082-2089(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The Diffuser Augmented Wind Turbine (DAWT) is one of the advanced concepts being investigated to improve the economics of wind energy conversion systems (WECS). Very compact diffusers using boundary layer control have been examined experimentally. Small scale model testing with screens and centerbodies to simulate a real turbine was used to choose a baseline diffuser configuration. This design is a conical, 60° included angle diffuser with an area ratio of 2.78 controlled by two tangential injection slots. The configuration also has been tested at ten times greater physical size and up to 3.5 times greater wind speed using screens and a real turbine. This first generation, nonoptimized DAWT configuration should provide about four times the power of a conventional WECS with the same turbine efficiency, diameter, and wind at optimum turbine disk loading.

8429 **Torque ripple in a vertical axis wind turbine.** Reuter, R.C. Jr.; Worstell, M.H. (Sandia Lab, Albuquerque, NM). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 2090-2098(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Torque ripple is a name given to time variations in torque which are propagated through the drive train of wind energy conversion systems. This paper covers an analytical and experimental investigation of torque ripple in a Darrieus vertical axis wind turbine. An analytical model of the turbine is described and numerical results from a solution to the equations of this model are compared to experimental results obtained from the existing DOE/Sandia 17 meter vertical axis wind turbine. Discussions on the sources of torque ripple, theoretical and experimental correlation, and means of suppressing its magnitude are included.

POWER CONVERSION SYSTEMS

8430 (CONF-790352—, pp 366-376) **Wind energy conversion system transient performance analysis.** Price, W.W. (General Electric Co., Schenectady, NY); Macklis, S.L. Jun 1979.

From Workshop on economic and operational requirements and status of large scale wind systems; Monterey, CA, USA (26 Mar 1979).

Wind Turbine Generators (WTG's) are subject to continuous torque disturbances due to gusting wind conditions, as well as tower shadow and wind shear effects. This unique feature of WTG's has led to a concern over the voltage fluctuations and possible stability problems which may result when Wind Energy Conversion Systems (WECS) are applied to electric utility systems. Specifically, the question is whether objectionable voltage fluctuations or stability problems will preclude certain WECS applications or limit the size of WTG's for certain applications and whether special system designs will be necessary to insure successful operation.

8431 **SIMWEST: a simulation model for wind energy storage systems.** Edsinger, R.W.; Warren, A.W.; Gordon, L.H.; Chang, G.C. (Boeing Comput Serv, Energy Technol Appl). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 2108-2114(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

This paper describes a comprehensive and efficient computer program for the modeling of wind energy systems with storage. The level of detail of SIMWEST is consistent with evaluating the economic feasibility as well as the general performance of wind energy systems with energy storage options. The software package consists of two basic programs and a library of system, environmental, and control components. The first program is a precompiler which allows the library components to be put together in building block form. The second program performs the techno-economic system analysis with the required input/output, and the integration of system dynamics. An example of the application of the SIMWEST program to a current 100 KW wind energy storage system is given.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 8000, 8708, 8727, 8727, 8728

8432 **Integrated economic-engineering approach to large-scale system effectiveness.** Sand, F.M. (ECON, Inc, Princeton, NJ). pp 57-61 of Second Lawrence symposium on systems and decision sciences. North Hollywood, CA; West Period Co. (1978).

From 2. symposium on systems and decision sciences; Berkeley, CA, USA (2 Oct 1978).

Two different views of the value of service reliability in electric-power systems: (1) as viewed by economists and (2) as viewed by power-system engineers and planners, are contrasted. Reasons for the extraordinary differences in the optimum of price, reliability, and capacity choice are discussed. It is suggested that a new integrated economic-engineering approach is needed, in which realistic system planning requirements are brought together with sound economic-welfare optimization. A joint effort is under way at ECON and the Philadelphia Electric Company to develop such an integrated model.

8433 **Statistical characterizations of power system stability and security.** Blankenship, G.L.; Fink, L.H. (DOE, Washington, DC). pp 62-70 of Second Lawrence symposium on systems and decision sciences. North Hollywood, CA; West Period Co. (1978).

From 2. symposium on systems and decision sciences; Berkeley, CA, USA (2 Oct 1978).

Power-system stability is formulated as a qualitative, asymptotic property of the system "long-term dynamics." Power-system security is defined as an instantaneous time and spatially dependent measure of the viability of the system as a conditional functional of disturbance likelihood and available reserve actions. Tentative analytical formulations of these concepts are given in terms of simple models. Certain basic analytical problems are posed and discussed.

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 8573, 8664, 8665, 8690, 8691, 8692, 8693, 8694, 8695, 8696, 8710, 8711, 8714, 8731, 8732, 8741

8434 (DOE/NASA/1062—79/3) **Low NO/sub x/ heavy fuel combustor program.** Lister, E.; Niedzwiecki, R.W.; Nichols, L. (Department of Energy, Washington, DC (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. Contract EC-77-A-31-1062. 15p. (NASA-TM-79313). Dep. NTIS, PC A02/MF A01.

The Low NO/sub x/ Heavy Fuel Combustor Program is a part of the DOE/LeRC Advanced Conversion Technology Project (ACT). Main program objectives are to generate and demonstrate

the technology required to develop durable gas turbine combustors for utility and industrial applications, which are capable of sustained, environmentally acceptable operation with minimally processed petroleum residual fuels. The program will focus on dry reductions of oxides of nitrogen (NO/sub x/), improved combustor durability and satisfactory combustion of minimally processed petroleum residual fuels. Other technology advancements sought include: fuel flexibility for operation with petroleum distillates, blends of petroleum distillates and residual fuels, and synfuels (fuel oils derived from coal or shale); acceptable exhaust emissions of carbon monoxide, unburned hydrocarbons, sulfur oxides and smoke; and retrofit capability to existing engines.

8435 Economic optimization of the coal-fired MHD steam power plant. Chapman, J.N.; Crawford, L.W.; Dicks, J.B. (Univ of Tenn, Space Inst, Tullahoma). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1230-1235(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A computer based model of the MHD/Steam Power Plant is used to optimize the plant with regard to combustor temperature, combustor pressure and magnetic field strength. Cost of electricity is used as the measure of merit for the optimization. The results indicate that the combustor pressure should be 5 atmospheres for coal prices projected around 1990. The magnetic field and air preheat temperatures should be selected at the upper limit of the interval considered. Sensitivity of results to coal prices, seed flow rates and combustor heat loss is examined.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

8436 (EPRI-FP—1178) **Evaluation of ozone treatment in air conditioning cooling towers. Final report.** Merrill, D.T.; Drago, J.A. (Brown and Caldwell, Walnut Creek, CA (USA)). Sep 1979. 106p. Dep. NTIS, PC A06/MF A01.

Ozone is a potential alternative to chlorine and proprietary chemicals for treating cooling tower circulating water systems at electric power plants. This study surveyed air conditioning cooling tower systems which have used ozone treatment for the past few years. The performance of these systems and the implications of using ozone treatment in electric power plants were examined. Several sites were surveyed. Makeup and circulating water samples were taken at four sites using ozone treatment. The samples were analyzed for general mineral content, including parameters which affect chemical scaling. At two of these sites, cooling tower systems using proprietary chemical treatments were sampled for comparison. At selected sites, trihalomethanes, total plate counts, oxidant residuals, and trace metals were measured. The results indicate that ozone treatment warrants further study for application at electric power plants. For the ozone systems sampled, biological fouling was apparently controlled. The ozone systems operated at conditions far exceeding conventional chemical scale limitations. As a result chemicals were apparently precipitated, but seemingly settled out in the cooling tower basins rather than fouling heat exchange surfaces. The failure of one system operating at elevated water temperatures indicates that the limits of ozone treatment must be determined before this technology is applied at electric power plants.

POWER CYCLES

REFER ALSO TO CITATION(S) 8757

8437 Geothermal preheating in fossil-fired steam power plants. Khalifa, H.E.; DiPippo, R.; Kestin, J. (Brown Univ, Providence, RI). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1068-1073(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The paper presents a thermodynamic analysis of a hybrid fossil geothermal power plant in which low-grade geothermal energy is used for preheating feedwater in a fossil-fired steam power plant. By restricting the geofluid to sensible heat addition, the entropy production in this process can be reduced. This results in an overall improvement in the utlization of the two energy sources. The performance of the hybrid system is studied in terms of suitably defined figures of merit. These include criteria for the choice of the appropriate hybrid utilization strategy, given the finite nature of geothermal and fossil resources. The paper also addresses the question of optimum bleed conditions in a cycle comprising both geothermal an regenerative feedwater heating.

8438 Organic bottoming ccgt systems: a limited opportunity. Wilkinson, W.H.; Hanna, W.T. (Battelle, Columbus Lab, Ohio). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1494-1499(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Ideal thermodynamic performance of closed-cycle gas turbine (CCGT) bottoming cycles is defined and comparison with representative organic bottoming fluids is made. Overall system performance is presented, comparing the efficiencies and the heat exchanger size factor for Class 1 (organic) and Class 2 (steam) bottoming of CCGT cycles. Preferred cases are selected and cost of electricity is extrapolated. Areas of cost reduction are discussed and the relative competitive position of organic bottoming CCGT systems is shown to be marginal at best.

8439 Department of energy's thermionic energy conversion program. Merrill, O.S. (US Dep of Energy, Washington, DC). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 1880-1886(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The use of thermionic energy conversion (or TEC) as a topping cycle for central station powerplants is a viable option for achieving greater efficiency, and therefore substantial fuel savings, in the generation of electrical power than is currently being achieved by conventional utility plants. In recognition of this, the Department of Energy is supporting the development of TEC technology as one of the promising emerging technologies for high temperature waste heat utilization. This paper gives a condensed, preliminary version of DOE's plan for bringing TEC technology from the laboratory to the competitive, commercial marketplace within the next decade.

8440 Conceptual design of a thermionic-topped steam electric generator plant using an advanced boiler concept. Miskolczy, G.; Gunther, B.; Margulies, A.E. (Thermo Electron Corp, Waltham, Mass). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 1893-1897(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

An advanced boiler concept was developed which provides a configuration to thermally couple thermionic energy converters (TECs) to a steam cycle. This concept allows effective boiler heat transfer to the TECs to be increased with the benefit of increasing the operating efficiency of the TECs. The boiler is equipped with a TEC air preheater and with staged burners along its height so that the maximum combustion temperature (typically 1760 C or 3200 F) and a short residence time (approximately one second) are consistent with low NOSsub xS generation. Consequently, the average heat flux to the TECs is higher in an advanced boiler than in a conventional boiler. Cost estimates indicate that a TEC topped plant (800 MW total) using such an advanced boiler can be constructed for $618/kW. It is also shown that with TEC topping, a capital saving of $156/kW could be achieved as compared with an 800-MW conventional oil-fired plant.

WASTE-FUELED SYSTEMS

8441 Electricity from refuse. White, M. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1979). 51p. (NZERDC—44).

A study on the conversion of refuse to electricity for Auckland involves the combustion of refuse directly or as a refuse-derived fuel to release heat energy, which in turn is converted to high-pressure steam for driving steam turbogenerators. Refuse in this study covers domestic/commercial collected refuse, privately deposited domestic refuse, and industrial/commercial refuse. The investigation considers only technologies that have been basically proven by commercial operation and systems designed to make use, whenever possible, of existing plant and equipment. The following options are examined for close technical and economic assessment: mass burning in sloping grate boiler plant at Meremere Power Station, semi-suspension combustion boiler plant at Meremere Power Station; supplementary firing of a refuse-derived fuel at Huntley Power Station; and an Auckland based refuse-fueled power station using semi-suspension combustion boiler plant. Extensive data are compiled on: refuse from the Auckland urban area; design of systems; environmental and technical aspects. (MCW)

COMPONENTS

REFER ALSO TO CITATION(S) 8449, 8733

8442 (FE—2479-T) **Stabilization of essential rotating machinery for the fossil fuel industry. Annual report, August 1977-August 1978.** Lewis, D.W.; Allaire, P.E. (Virginia Univ., Charlottesville (USA)). Sep 1978. Contract EX-76-C-01-2479. 118p. Dep. NTIS, PC A06/MF A01.

The annual report summarizes the work of the second year of the research and follows the planned WORK SCHEDULE topic by topic that appeared in the original proposal. The report is broken down into five sections: (1) Sample of Financial Losses; (2) Design Guides/Criteria; (3) Diagnostic/Preventive Maintenance Information; (4) Computer Programs; and (5) Experimental Work. In an

attempt to make the results of this work available to the general public, as soon as possible, technical reports have been written and submitted for publication in the technical and scientific journals. Abstracts as well as the appropriate references to the journals are presented. Because of the delay between acceptance of technical journal articles for publication and actual publication of the journal, a number of articles are indicated as accepted for publication.

8443 (INKA-Conf—78-382-001) **Process control by microprocessors.** Arndt, W. (ed.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Prozesslenkung mit DV-Anlagen; VDI/VDE-Gesellschaft Mess- und Regelungstechnik, Duesseldorf (Germany, F.R.). Ausschuss Kernreaktorregelung). Dec 1978. 456p. (In German). (CONF-781251—; KFK-PDV—165). Dep. NTIS (US Sales Only), PC A20/MF A01.

From Technical meeting on process control with microprocessors; Karlsruhe, F.R. Germany (19 Dec 1978).

Papers from the workshop Process Control by Microprocessors being organized by the Karlsruhe Nuclear Research Center, Project PDV, together with the VDI/VDE-Gesellschaft fuer Mess- und Regelungstechnik are presented. The workshop was held on December 13 and 14, 1978 at the facilities of the Nuclear Research Center. The papers are arranged according to the topics of the workshop; one chapter deals with today's state of the art of microprocessor hardware and software technology; 5 chapters are dedicated to applications. The report also contains papers which will not be presented at the workshop. Both the workshop and the report are expected to improve and distribute the know-how about this modern technology.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 8814

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 8586, 8587, 8588

FUELS

REFER ALSO TO CITATION(S) 8058, 8220, 8667, 8668, 8669, 8670, 8671, 8672, 8673, 8674, 8675, 8676, 8677, 8684

8444 (DSD—106) **Fuel requirements of a 50-MW wood-fired electrical-generating facility in northern Vermont.** Sherwood, L.; Meadows, D. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). Jul 1978. 19p. Resource Policy Center, Hanover, NH.

In order to assess the fuel requirements of a 50-MW wood-fired power plant (WFPP) located in northern New England, two factors affecting the heat value of wood - chemical composition and moisture content - are examined. Because the latter is the primary determinant of Btu output, the average moisture content of green wood in the study region, nine counties in northern Vermont, is estimated. At about 47% wet basis, the average moisture content results in an effective heat content, weighted by the relative abundance of species in the region, of about 4100 Btu per pound of green wood harvested in the area. Thus approximately 800,000 green tons of wood chips will be required annually to fuel a 50-MW WFPP operating at 97% capacity in the region. However, equipment that uses waste heat from the plant to reduce the moisture in the fuel prior to combustion could reduce the wood requirements of the facility by up to 30%. Three other estimates of the annual fuel consumption of a 50-MW WFPP have appeared in the literature; they range from 410,000 to 500,000 green tons. These studies use plant capacity factors lower than those made in this study and underestimate the effect of moisture in reducing the conversion efficiency of the plant.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 8445, 8712, 9058, 9061, 9063, 9064, 9097, 9143, 9146, 9172, 9320

8445 (EPA/600/9—78-022, pp 353-370) **Integrated assessment of electric utility systems.** Cukor, P.M. (Teknekron, Inc., Berkeley, CA); Large, D.B; Niemann, B.L.; Van Horn, A.J.; Smith, L.F. Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

The electric utility industry through its investment and operating decisions influences the nation's economy and the environment. In turn, the utilities' decisions are influenced by various factors: government energy and environmental policies, economic conditions, and technological consideration. Teknekron has developed a framework for assessing in an integrated manner the impact of these factors on the future investment and operating decisions made by utility firms. It is shown that the growth and development of the U.S. electric utility industry will be influenced by regulatory constraints, electricity demand, the costs and availability of technologies for electricity generation and pollution control, and conditions in the nation's economy. Utility investment and operating decisions, in turn, will be reflected in revenue requirements, which determine electricity prices, and in fuel consumption, which leads to releases of air and water pollutants and to the generation of solid wastes. This integrated assessment analyzes the regional air quality impacts of the decisions utilities are likely to make in response to alternative energy and environmental policies and economic and technical conditions. The integrated assessment process depends on Teknekron's Utility Simulation Model which consists of interconnecting computer modules and data bases that simulate decisions for system planning and operation, utility finance, and the operation of individual technical processes such as pollution control devices.

8446 (NUS—3368) **Identification of hazards in non-nuclear power plants. Volume 1. Summary report. Phase I and Phase II. Consultant report.** (NUS Corp., Rockville, MD (USA)). Aug 1979. 30p. California Energy Commission, Sacramento, CA.

This report summarizes the first step in an evaluation of the public health and safety hazards associated with non-nuclear plants. The study was limited to hazards that could affect the general public outside the plant boundaries. Public health and safety hazards are identified for seven types of power plants: coal-fired conventional boiler, atmospheric fluidized bed boiler, pressurized fluidized bed-combined cycle, oil-fired, oil-fired steam turbine, combined cycle, combustion (gas) turbine, and geothermal. Major plant systems associated with specific hazards are identified and described. Potentially hazardous conditions and events are identified for normal and abnormal plant operating conditions and for accidents at the plant. A classification of each hazard identifies the initiating event, the hazard source, equipment, or conditions that increase, monitor, or mitigate the hazard. An event tree developed for each plant relates the effect on the general public for each hazard and initiating event. A semi-quantitative hazard ranking provides a method of comparing the hazards and events at different types of plants. Consideration is given to the sensitivity of the hazard ranking to population density, changes in operating mode, and technology changes.

8447 **Utility line siting and wetlands preservation.** Quigley, E. (Univ. of Wisconsin, Madison). pp 175-177 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

This study of the interface between the issues of utility line siting and wetlands preservation attempts to determine the extent of the impact of utility lines in wetlands by examining existing sites. This method of environmental impact study permits a comparison of impacts through time. Both the natural physical environment and the political environment need to be considered in a study of utility line siting and wetlands preservation. 213 electric transmission line sites and 42 large diameter pipeline sites in Wisconsin were examined with 34 variables pertaining to wetland site description, utility line characteristics and land use characteristics recorded for each site. Detailed studies of the impact of a 138 kV electric transmission line and a 16 inch diameter underground natural gas pipeline on the hydrology and vegetation of a southern Wisconsin marsh were made. The information was used to construct models of impacts of utility lines on wetlands. Legislation enacted in over twenty-five states dealing with both utility line siting and wetlands preservation was examined. Utilities are commonly granted exemptions in wetlands protection legislation.

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 9259, 9260, 9261

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 8052, 8062

8448 (BM-RI—8403) **Flue gas desulfurization by the modified citrate process.** Lien, R.H.; Martin, D.A.; Nissen, W.I. (Bureau of Mines, Salt Lake City, UT (USA). Salt Lake City Research Center). 1979. 22p. Bureau of Mines, Washington, DC.

The Bureau of Mines, US Department of the Interior, has developed a flue gas desulfurization process as part of its goal of minimizing the undesirable environmental impacts associated with energy and mineral-processing plants. This process, known as the citrate process, involves absorption of sulfur dioxide (SO_2) in a buffered solution of citric acid. The SO_2-loaded solution is regenerated by reaction of the SO_2 with hydrogen sulfide (H_2S) to form elemental sulfur. As an adjunct to the citrate process, bench-scale research has shown that SO_2-loaded citrate or glycolate solutions can be regenerated by countercurrent contact with steam (stripping)

in packed towers. Concentrated SO_2 is produced by condensing the steam from the stripper product. Thus, steam stripping provides strong SO_2 gas for liquefaction, sulfuric acid production, or reduction to elemental sulfur. Stripping steam requirements were determined for treatment of 0.25 to 0.50-, 1.0- and 2.0-%-SO_2 waste gases. Steam requirements decreased with increasing SO_2 concentrations in the simulated waste gases. For example, 5 grams of steam per gram of SO_2 was required to remove 90% of the SO_2 from a simulated copper smelter gas (2.0% SO_2), while 30 grams of steam per gram of SO_2 was needed for 90% SO_2 removal from a simulated coal-fired power-plant gas (0.25% SO_2).

8449 (EPA—450/3-78-045) **Electrostatic precipitator costs for large coal-fired steam generators.** (Industrial Gas Cleaning Inst., Inc., Stamford, CT (USA)). Feb 1977. 49p. Environmental Protection Agency, Research Triangle Park, NC.

This study was performed to determine the costs for electrostatic precipitators to control particulate emission from large coal-fired steam generators with such costs to be a function of different coal types, boiler sizes, and emission limits, and to identify the total costs that will result from the addition of electrostatic precipitators to the proposed new generating capacity in the USA, factoring into these costs coal types, emission limits, and boiler sizes. Information is included on precipitator design specifications, and investment and operating costs for projected new boiler capacity with hot side and with cold side location of the electrostatic precipitators. (LCL)

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 8709

AC SYSTEMS, EHV AND UHV

8450 (CONS—3107-T3) **Evaluation, design, development and delivery of a 1200 kV prototype termination. Third technical progress report, May 1, 1979-August 31, 1979.** Billings, J.S.; Neri, Z.; Meyer, J.R.; Burkhart, J.P.; Donohue, E.P.; Tragesser, C.W.; Bennett, A.I. Jr. (Westinghouse Electric Corp., Trafford, PA (USA). Power Circuit Breaker Div.). Sep 1979. Contract ET-78-C-01-3107. 67p. Dep. NTIS, PC A04/MF A01.

Detailed analytic and model studies of various termination concepts underway during the present period are described. Reduced scale models are being constructed for the electrostatic and the mechanical studies. Sample tests on a glass fiber reinforced insulating material show promise of an improved shatter-resistant weathercase material. Thermal analysis show that most of the termination designs being considered appear to have acceptable thermal profiles. Optimal materials, configurations, and fabrication plans are expected to be determined upon completion of these studies.

NUCLEAR POWER PLANTS

8451 (DOE/NE—0030/4(79)) **US Central station nuclear electric generating units: significant milestones.** (Department of Energy, Washington, DC (USA)). Dec 1979. 43p. Dep. NTIS, PC A03/MF A01.

Construction and operational milestones are tabulated for US nuclear power plants. Data are presented on nuclear steam supply system orders. A schedule of commercial operation through 1990 is given.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 8493, 8495, 8507, 8531, 8549, 8551, 8553, 8558, 8866

8452 (COO—4066-11) **Description and characterization of HBWR Series H-1 test rods.** Wagoner, S.R.; Barner, J.O.; Welty, R.K. (Battelle Pacific Northwest Labs., Richland, WA (USA); Exxon Nuclear Co., Inc., Richland, WA (USA)). Jun 1979. Contract EY-76-C-02-4066;EY-76-C-06-1830. 160p. (PNL—2906). Dep. NTIS, PC A08/MF A01.

The as-built characterization results are presented for the HBWR Series H-1 test rods to be irradiated as part of the Fuel Performance Improvement Program (FPIP). The irradiation of these rods is to be conducted in the Halden Boiling Water Reactor (HBWR). Series H-1 consists of twelve rods for irradiation and six spares. Rod design types include (1) a reference dished pellet design, (2) an annular pellet design, (3) an annular pellet design combined with graphite-coated cladding, and (4) a packed-particle (vipac) design. The report, which describes the fabrication and detailed characterization results for the rods, is divided into four major sections: (1) experiment description, (2) process development required to fabricate the test rods, (3) methods and procedures used to fabricate and characterize the rods, and (4) a summary of the characterization results.

8453 (IAEA-R—1706-F) **Optimization theory and fuel and absorber management problems of light water reactors. Part of a coordinated programme on burn-up calculations and experiments for thermal reactors. Final report for the period 1 December 1975 - 30 September 1977.** Urli, N.B. (International Atomic Energy Agency, Vienna (Austria)). Jan 1978. 14p. Dep. NTIS (US Sales Only), PC A02/MF A01.

This report is an initial step to develop a complete set of computer programs in Yugoslavia dealing with fuel burnup, local and global reactor calculations, and fuel shuffling and reloading.

8454 (LA—8036-PR, pp 29-31) **ANS 5.1 decay power standard.** England, T.R.; LaBauve, R.J.; Wilson, W.B.; Whittemore, N.L. Sep 1979.

In Applied nuclear data research and development. Progress report.

The calculations used in the establishment of an ANSI Standard for the decay power in PWR and BWR type reactors are analyzed.

8455 (NUREG/CR—0749) **Thermal and mechanical behavior of a xenon-filled fuel rod as a function of burnup.** Cunningham, M.E.; Lanning, D.D.; Williford, R.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 56p. (PNL—3075). Dep. NTIS, PC A04/MF A01.

The life history behavior is examined for Rod 4, IFA-431 based on in-reactor fuel centerline temperature and cladding elongation data, and post-irradiation, non-destructive examination. Instrumented fuel assembly IFA-431 was irradiated in the Halden Boiling Water Reactor from June 1975-February 1976. Rod 4 of this assembly was built with concentric and eccentric fuel regions and then backfilled with 100% xenon gas in order to study the effects of fill gas composition and fuel-cladding geometry. It has been concluded that fuel relocation was responsible for the significant decrease in thermal resistance that was observed for the concentric fuel region. The thermal resistance for the eccentric fuel region was lower than for the concentric region (for equal linear heat rate) and remained nearly constant during the irradiation.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 8452, 8453, 8454, 8455, 8493, 8495, 8507, 8510, 8528, 8530, 8531, 8538, 8546, 8548, 8551, 8553, 8555, 8556, 8558, 8850, 8866

8456 (CONF-791118—6) **Measurements of radionuclide concentrations in liquid and gaseous streams in PWR's.** Mandler, J.W.; Motes, B.G. (EG and G Idaho, Inc., Idaho Falls (USA); Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 27p. Dep. NTIS, PC A03/MF A01.

From 7. water reactor safety research information meeting; Gaithersburg, MD, USA (5 Nov 1979).

Measurements of radionuclide concentrations in liquid and gaseous streams in pressurized water reactors (PWR's) were performed as part of the In-Plant Source Term Measurement Study which is being carried out under NRC sponsorship. Some of the measurement results obtained together with brief descriptions of the measurement program and the methods used in the study are presented.

8457 (COO—4711-19) **Qualification of the B and W Mark B fuel assembly for high burnup. First semi-annual progress report, July-December 1978.** Coleman, T.A.; Coppola, E.J.; Doss, P.L.; Uotinen, V.O.; Davis, H.H. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.; Babcock and Wilcox Co., Alliance, OH (USA). Contract Research Div.; Babcock and Wilcox Co., Lynchburg, VA (USA). Research and Development Div.; Duke Power Co., Charlotte, NC (USA)). Aug 1979. Contract ET-78-C-02-4711. 82p. (BAW—1546-1). Dep. NTIS, PC A05/MF A01.

Five Babcock and Wilcox standard Mark B (15 x 15) fuel assemblies are being irradiated in Duke Power Company's Oconee Unit 1 reactor under a research and development program sponsored by the U.S. Department of Energy. Valuable experimental data on fuel performance characteristics at burnups of $>$ 40,000 MWd/mtU will be obtained from these assemblies. This information, at a duty approximately 20% greater than that achieved by typical discharged

assemblies, will be used to qualify standard Mark B fuel assemblies for extended burnups. Efforts during this period included fuel cycle design and reload licensing of Oconee 1 for cycle 5, in which the assemblies are being irradiated, and nondestructive examination of the assemblies during the refueling outage between cycles 4 and 5. The Oconee 1 cycle 5 startup tests proceeded in a routine manner, and the reactor has operated with a 92% capacity factor since completion of power escalation testing on November 10, 1978. Irradiation of the fuel assemblies is currently in progress.

8458 (EPRI-NP—1088(Pt.1)) **Integral experiments for PWR U-tube steam generators. Part 1: freon facility description and performance test results.** Adams, G.; Duffy, D.; Lapson, B.; Lundberg, R. (Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.). Aug 1979. 142p. Dep. NTIS, PC A07/MF A01.

A detailed description is provided on the design/building of a scale model facility for simulating a typical commercial PWR U-tube steam generator. The flow regime visualization is emphasized in the design. The facility has been built and the experiments on the thermal-hydraulic response of the system have been performed. The results based on these experiments have been presented. The performance limits, recirculating flow behavior and heat transfer characteristics have been expressed in terms of the system parameters. The thermal-hydraulics of a commercial prototypical system have been assessed using conventional fluid-to-fluid modeling analysis.

8459 (IEA-DT—093) **Model for reliability avaliation of the electrical supply source of the 1A3 and 1A4 control rods assemblies of Angra I reactor.** Yang, T. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Nov 1978. 60p. (In Portuguese). Dep. NTIS (US Sales Only), PC A04/MF A01.

The reliability of the electrical power supply to the 4.16KV buses for the safety system operation of a nuclear power plant was studied. Particularly, Angra Unit I system was focused. Initially, reliability of each electrical supply source was estimated. Using a probabilistic approach based on the Markov processes, the system reliability was evaluated in terms of frequency and duration of loss of power supply and of the system failure probability evolution when one or more sources remained unavailable. Based on these results, certain reactor operating rules were proposed concerning later shutdown of the plant without compromising the nuclear reactor safety. A sensitivity analysis was also performed to show the different reliability parameter influences on final results. This analysis showed that the diesel system performs an important role in the power supply for a nuclear power plant.

8460 (KFK—2696) **Chemical state of LWR high power rods under irradiation.** Kleykamp, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Jan 1979. 23p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

One cross section of a high power fuel rod irradiated up to 4.3% burnup at a mean linear rating of 43 kW/m in the KWO reactor has been investigated by electronprobe microanalysis. The concentration of the converted plutonium and the most important fission products dissolved and precipitated in the fuel is given as a function of the fuel radius. The radial xenon release is evaluated. The oxygen concentration profile in the zircaloy cladding is determined. The reaction layers at the inner clad surface are identified to be α-Zr(0) and a Cs-Zr-0 phase. A thermal analysis of the cross section is carried out. The radial dependence of the EOL fuel stoichiometry is calculated using the composition of some fission product precipitates, the oxidation state of metallic impurities and the oxygen content in the α-Zr(0) phase, which results in O/M = 2.00- throughout the fuel radius.

8461 (LA—8036-PR, pp 31-35) **Three Mile Island calculations.** Wilson, W.B.; England, T.R.; LaBauve, R.J.; Whittemore, N.L. Sep 1979.

Ir Applied nuclear data research and development. Progress report.

Calculations of decay heating source terms (fission products and actinides), beta- and gamma-decay spectra, and gas content following the Three Mile Island-2 incident are presented.

8462 (UJV—4597-T,E) **Estimated costs of reactor pressure vessels.** Havel, S.; Kadlec, J.; Kasak, F. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Aug 1978. 20p. (In Czech). Dep. NTIS (US Sales Only), PC A02/MF A01.

Costs were estimated of the manufacture of reactor pressure vessels. The basic technical problems of pressure vessel production are summed up and, based on literature data, costsare estimated of producing pressure vesqgls fmr WWER-40 and WWER-100 reactorsin Czechoslovakia. Some factors affecting the costs of the vesseN production in Czechoslovakia are discussed.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 8496, 8544, 8545

8463 (CEA-CONF—4310) **High temperature friction and seizure in gas cooled nuclear reactors.** Cousseran, P.; Febvre, A.; Martin, R.; Roche, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. des Etudes Mecaniques et Thermiques). 1978. 43p. (In French). (CONF-780289—1). Dep. NTIS (US Sales Only), PC A03/MF A01.

From One-day meeting on dry friction; Paris, France (1 Feb 1978).

One of the most delicate problems encountered in the gas cooled nuclear reactors is the friction without lubrication in a dry and hot (800°C /1472°F) helium atmosphere even at very small velocity. The research and development programs are described together with special tribometers that operate at mode than 1000°C (1832°F) in dry helium. The most interesting test conditions and results are given for gas nitrited steels and for strongly alloyed Ni-Cr steels coated with chromium carbide by plasma sprayed. The effects of parameters live velocity, travelled distance, contact pressure, roughness, temperature and prolonged stops under charge are described together with the effects of negative phenomena like attachment and chattering.

8464 (GA-A—15258) **Core design calculations for MEU fuel in FSV.** Fehrenbach, M.E.; Baxter, A.M. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract EY-76-C-03-0167-065. 55p. Dep. NTIS, PC A04/MF A01.

Results of a study on the feasibility of converting the Fort St. Vrain reactor core from the present 6-year, High Enriched Uranium (HEU) fuel cycle using uranium enriched to 93% U-235 and thorium to a 6-year, Medium Enriched Uranium (MEU) fuel cycle using uranium enriched to 20% U-235 and thorium, are described. The study shows that a transition from the HEU to MEU cycle can be accomplished, and that operation of the FSV core on a straight MEU cycle is feasible within present Tech. Spec. limits.

8465 (GA-A—15429) **HTGR-SC 900-MW(e) Reference Plant nuclear steam supply system conceptual design and status report. Volume I. Description and status.** (General Atomic Co., San Diego, CA (USA)). Sep 1979. Contract AT03-76ET35301. 38p. Dep. NTIS, PC A17/MF A01.

This report, comprising Volumes I and II, presents the conceptual design and status of the nuclear steam supply (NSS) for the High-Temperature Gas-Cooled Reactor - Steam Cycle (HTGR-SC) 900-MW(e) Reference Plant as of April 1979. The report is intended to serve as a baseline should the program be continued.

8466 (GA-A—15451) **Fort St. Vrain refueling equipment calculations versus measurements.** Engholm, B.A. (General Atomic Co., San Diego, CA (USA)). Aug 1979. Contract AT03-76ET353000. 80p. Dep. NTIS, PC A05/MF A01.

Gamma-ray dose rate measurements made during the first refueling of the Fort St. Vrain HTGR (owned and operated by the Public Service Company of Colorado) were compared with calculations in order to check the adequacy of the refueling equipment shielding, validate the analytical methods used, and provide design guidance for the shielding design of future HTGRs.

8467 (GA-A—15585) **Effects of the HTGR-gas turbine on national reactor strategies.** Ligon, D.M.; Brogli, R.H. (General Atomic Co., San Diego, CA (USA)). Nov 1979. Contract AT03-76ET35300. 27p. Dep. NTIS, PC A03/MF A01.

A specific role for the HTGR in a national energy strategy is examined. The issue is addressed in two ways. First, the role of the HTGR-GT Binary cycle plant is examined in a national energy strategy based on symbiosis between fast breeder and advanced converter reactors utilizing the thorium U233 fuel cycle. Second, the advantages of the HTGR-GT dry-cooled plant operating in arid regions is examined and compared with a dry-cooled LWR. An event tree analysis of potential benefits is applied.

8468 (SGAE—2955) **Testing facility for large scale models at 100 bar and 300°C to 1000°C.** Zemann, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Jul 1978. 16p. (RS—136/78). Dep. NTIS (US Sales Only), PC A02/MF A01.

A testing facility for large scale model tests is in construction under support of the Austrian Industry. It will contain a Prestressed Concrete Pressure Vessel (PCPV) with hot linear (300°C at 100 bar), an electrical heating system (1.2 MW, 1000°C), a gas supply system, and a cooling system for the testing space. The components themselves are models for advanced high temperature applications. The first main component which was tested successfully was the PCPV. Basic investigation of the building materials, improvements of concrete gauges, large scale model tests and measurements within the structural concrete and on the liner from the beginning of

construction during the period of prestressing, the period of stabilization and the final pressurizing tests have been made. On the basis of these investigations a computer controlled safety surveillance system for long term high pressure, high temperature tests has been developed.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 8543

8469 (JAERI-M—7711) **Preliminary analysis of data for IFA-508(I). II. Diameter deformation of fuel rod; irradiation period: June to July, 1977, attained burnup: 70 MWd/tUO$_2$.** Yanagisawa, K. (Japan Atomic Energy Research Inst., Tokyo). Jun 1978. 52p. (In Japanese). Dep. NTIS (US Sales Only), PC A04/MF A01.

The results are described of irradiation experiments of JAERI's instrumented fuel assembly with HBWR. Presented are the preliminary analysis of cladding diameter variation and data. Irradiation period is covered from June to July 1977, with attained burnups 70 MWd/tUO$_2$. Obtained results are the following: (1) Wavy deformations of claddings are observed. (2) Physical quantities of RIDGE Dr, SUBRIDGE Ds and TROUGH DIAMETER Dt are defined. (3) RIDGE Dr increases with linear heat rating. Dr, Ds and Dt values depend on fuel gap and thickness of the cladding. (4) The thin clad, small gap fuel rod at a maximum output power (500 W/cm) shows a maximum strain 0.20% of Dr and permanent strain 0.13%. The thick clad, small gap fuel rod at a maximum output power (500 W/cm) shows a maximum strain 0.14% of Dr and permanent strain 0.05%. (5) Dr depends on the rigions of bottom, middle and top of the fuel rod, due significantly to the effect of SUBRIDGE Ds. (6) In the relaxation during high output power holding, there is thickness effect of the cladding. The correspondence between axial and diametral strains is good in the thin cladding, but not in the thick one. Deformation behaviors in axial and diametral directions are similar. (7) Calculation by FEMAXI code agrees well with experiment.

8470 (JAERI-M—7726) **Irradiation, post-irradiation examination, and evaluation of IFA-208 and 224.** Yanagisawa, K. (Japan Atomic Energy Research Inst., Tokyo). Jul 1978. 95p. (In Japanese). Dep. NTIS (US Sales Only), PC A06/MF A01.

This paper describes the analysis of IFA-208 and of IFA-224 irradiation tests at HBWR. As for IFA-208, the hollow pellet fuel with flat ends, one end dished and both ends dished pellet were irradiated to the average burnup of 5.1GWd/tUO$_2$ at the average linear heat rating of 615W/cm. After irradiation the fuel showed excellent dimensional stability. As for IFA-224, both the solid and the hollow pellet fuel with flat ends and both ends dished pellet were irradiated to the average burnup of 11.8GWd/tUO$_2$ at the average linear heat rating of 590W/cm. No major defects were observed, but two small sunburst blisters were found. Cladding strains were very small and no ridge deformation occurred. Cladding deformation was smaller and saturated quickly in low density pellets than in high density ones. Both ends dished pellet was affected largely by pellet density variation than flat end pellets. Fuel center temperature was lower in low density pellets than in high density pellets but that difference was not remarkable.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 8526, 8527, 8533, 8536, 8541, 8552, 8554, 8557, 8559, 8643, 8646, 8853, 8854, 8867, 8868, 8869, 8870, 8871, 8872, 8873, 8874, 8875, 8876

8471 (BNL—50991, pp 287-295) **Reactor application of actinide cross section data.** Beaman, S.L.; Cowan, C.L. (General Electric Co., Sunnyvale, CA). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

Uncertainties in the cross section data for the higher plutonium and americium isotopes have been investigated to determine their impact on the important LMFBR design parameters. The results of this investigation have indicated that the design calculations are sensitive to the uncertainties in the capture and fission data for ^{240}Pu and ^{241}Pu, and for long-term design applications these uncertainties should be reduced to less than about 10%. The uncertainties in the data for ^{243}Pu and for the americium isotopes have only a small impact on the fast reactor design studies but may be important in the development of schemes for the management of actinide waste discharge and for plutonium burnout.

8472 (CONF-7910112—2) **Current status of fast reactor physics.** Hummel, H.H. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 46p. Dep. NTIS, PC A03/MF A01.

From NEACRP meeting; Paris, France (1 Oct 1979).

The subject of calculation of reactivity coefficients for fast reactors is developed, starting with a discussion of the status of relevant nuclear data and proceeding to the subjects of group cross section generation and of methods of obtaining reactivity coefficients from group cross sections. Reactivity coefficients measured in critical experiments are compared with calculated values. Dependence of reactivity coefficients on reactor design is discussed. Finally, results of the recent international comparison of calculated reactivity coefficients are presented.

8473 (COO—2245-70) **Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, March 1-May 31, 1979.** Todreas, N.E.; Golay, M.W.; Wolf, L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1979. Contract EY-76-S-02-2245. 68p. Dep. NTIS, PC A04/MF A01.

Progress is summarized concerning liquid flow in bundle geometry (wrapped and bare rods) and LMFBR outlet plenum flow mixing.

8474 (ETEC-TDR—79-11) **Head-flow mapping and low NPSH testing of a prototypic subscale inducer pump at SCTL.** Haroldsen, O.O. (Energy Technology Engineering Center, Canoga Park, CA (USA)). 25 Sep 1979. Contract EY-76-C-03-0700. 180p. AT.

A series of tests have been conducted in sodium on a prototypic subscale inducer pump designed by the Atomics International Division of Energy Systems Group. The tests, consisting of head-flow mapping and low NPSH operation were successful. The pump was removed from the SCTL test system and returned to Atomics International for inspection and preparation for future testing.

8475 (GA-A—15563) **Reliability assessment of main loop residual heat removal options in the GCFR.** Taniguchi, T.; Torri, A. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76SF71023. 13p. (CONF-790816—83). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Reliability of decay heat removal is an important safety consideration in the Gas-Cooled Fast Breeder Reactor (GCFR). The design evolution of the residual heat removal (RHR) systems over the past few years has been markedly aided by system reliability analyses and has resulted in design improvements which greatly reduce the probability of a loss of coolable core geometry. This evolution consisted partly in improvements to the main loop residual heat removal system because analysis of an early design of the GCFR main loop residual heat removal system has shown that its reliability was substantially limited due to single failure points both in the BOP portion of the power conversion system as well as in the support systems. As a power result, 16 improved main loop residual heat removal options were identified and analyzed for their potential to improve heat removal train reliability.

8476 (GA-A—15579(Vol.1)) **CASY: a dynamic simulation of the gas cooled fast breeder reactor core auxiliary cooling system. Volume 1. Technical discussion.** (JAYCOR, Del Mar, CA (USA)). Sep 1979. Contract AT03-76SF71023. 210p. Dep. NTIS, PC A10/MF A01.

This report documents the development of the digital computer simulation code CASY. CASY is designed to evaluate alternative systems to perform emergency core cooling. It is modular in form such that modifications can be made easily. CASY was independently validated by comparing similar analysis results with existing core and core auxiliary cooling system transient codes. CASY is written in the preprocessor language available at General Atomic entitled SYSL.

8477 (GA-A—15579(Vol.2)) **CASY: a dynamic simulation of the gas-cooled fast breeder reactor core auxiliary cooling system. Volume II. Example computer run.** (JAYCOR, Del Mar, CA (USA)). Sep 1979. Contract AT03-76SF71023. 237p. Dep. NTIS, PC A11/MF A01.

A listing of a CASY computer run is presented. It was initiated from a demand terminal and, therefore, contains the identification ST0952. This run also contains an INDEX listing of the subroutine UPDATE. The run includes a simulated scram transient at 30 seconds.

8478 (HEDL-SA—1903-FP) **High voltage instrument cables for 650°C in-vessel breeder reactor service.** Cannon, C.P. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1979. Contract EY-76-C-14-2170. 16p. (CONF-791037—5). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

MgO insulated nuclear instrument cables have been developed for use in the Fast Flux Test Facility (FFTF) and breeder reactor in-vessel environments. Prototype cables have been successfully fabricated and tested: voltage Breakdown Pulse Noise (BPN) thresholds in excess of 800 Vdc and cable resistivities in excess of 10^9 Ω .ft were achieved at temperatures to 650°C. Factors demonstrated to strongly affect breakdown phenomena and insulation resistance in bulk cable were insulation and backfill gas purity (especially as affected by fabrication processing), compaction density, and high temperature annealing. Substitution of copper electrical conductors did not adversely affect cable performance if fabrication parameters were appropriately adjusted. Preliminary gamma irradiation tests on bulk MgO cable indicate that the gamma flux decreases insulation resistance by an order of magnitude to 5 x 10^9 Ω . ft at 450°C.

8479 (HEDL-SA—1932) **Equipment for inspection of austenitic stainless steel pipe welds.** Boehmer, W.D.; Horn, J.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 20 Aug 1979. Contract EY-76-C-14-2170. 4p. (CONF-791008—4). Dep. NTIS, PC A02/MF A01.

From ASNT fall conference; St Louis, MO, USA (15 Oct 1979).

A computer controlled ultrasonic scanning system and a data acquisition and analysis system have been developed to perform the inservice inspection of welds in stainless steel sodium piping in the Fast Flux Test Facility. The scanning equipment consists of a six axis motion mechanism and control system which allows full articulation of an ultrasonic transducer as it follows the circumferential pipe welds. The data acquisition and analysis system consists of high speed ultrasonic waveform digitizing equipment, dedicated processors to perform on-line analysis, and data storage and display equipment.

8480 (HEDL-SA—1950-FP) **Carbon in sodium: a status review of the USA R and D work.** McCown, J.J.; Bagnall, C. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 42p. (CONF-791149—1). Dep. NTIS, PC A03/MF A01.

From IWGFR specialists meeting on carbon in sodium; Harwell, UK (26 Nov 1979).

A review is presented concerning R and D work on carbon in sodium with reference to LMFBR primary coolant circuits. The chemistry of carbon in sodium, analysis and monitoring of carbon in sodium, carbon meters, and problems of carbon in sodium are described. 31 references. (FS)

8481 (LA—8132-PR) **Examination of fast reactor fuels and FBR analytical quality assurance standards and methods. Progress report, July 1-September 30, 1979.** Maraman, W.J. (comp.). (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

This is the twentieth quarterly report on the Examination of Fast Reactor Fuels and Fast Breeder Reactor (FBR) Analytical Quality Assurance and Methods at the Los Alamos Scientific Laboratory. Most of the investigations discussed are of the continuing type. Results and conclusions described may therefore be changed or augmented as the work continues. Published reference to results cited in this report should not be made without obtaining explicit permission to do so from the person in charge of the work.

8482 (NUREG/CR—0790) **Topical report on fuel motion diagnostic systems.** Wright, S.A. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 75p. (SAND—79-0909). Dep. NTIS, PC A04/MF A01.

Five papers are presented concerning the performance of fuel motion detection systems for LMFBR type reactors and test facilities.

8483 (NUREG/CR—0846) **Analysis of ORNL pipe ratchetting tests TTT-1 and TTT-2.** Swenson, D.V. (Sandia Labs., Albuquerque, NM (USA)). Jul 1979. Contract EY-76-C-04-0789. 33p. (SAND—79-1057). Dep. NTIS, PC A03/MF A01.

The benchmark problem described is based on an experiment performed at the Oak Ridge National Laboratory (ORNL) to obtain data for qualification of high temperature inelastic analysis methods. Both the material and loadings are representative of conditions in a Liquid Metal Fast Breeder Reactor. In the experiment two straight pipe test specimens were subjected to thermal downshocks, changes in internal pressure, and creep at elevated temperature. These loadings produced progressive inelastic deformations (ratchetting) of the test specimens.

8484 (ORNL/TM—6979) **Breakdown voltage at the electric terminals of GCFR-core flow test loop fuel rod simulators in helium and air.** Huntley, W.R.; Conley, T.B. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

Tests were performed to determine the ac and dc breakdown voltage at the terminal ends of a fuel rod simulator (FRS) in helium and air atmospheres. The tests were performed at low pressures (1 to 2 atm) and at temperatures from 20 to 350°C (68 to 660°F). The area of concern was the 0.64-mm (0.025-in.) gap between the coaxial conductor of the FRS and the sheaths of the four internal thermocouples as they exit the FRS. The tests were prformed to ensure a sufficient safety margin during Core Flow Test Loop (CFTL) operations that require potentials up to 350 V ac at the FRS terminals. The primary conclusion from the test results is that the CFTL cannot be operated safely if the terminal ends of the FRSs are surrounded by a helium atmosphere but can be operated safely in air.

8485 (UJV—4333-T) **Heat transfer in the peripheral region of a fast reactor fuel assembly. Part I. Experimental equipment; solution prerequisites, technological experiments.** Sulc, V.; Masek, V. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). May 1978. 52p. (In Russian). Dep. NTIS (US Sales Only), PC A04/MF A01.

Sodium stand S III was reconstructed at UJV Rez for the research of the effect of radial displacement of a side rod on the temperature field in a BN-600 fast reactor fuel assembly. A model was built of the BN-600 type fast reactor fuel assembly designated EK-16 containing 14 heating and 2 measuring rods. In heated rods the maximum linear heat flow of 53 W/cm was attained on the outer rod surface. The differential equation is solved of the temperature field on a heating rod consisting of a heating coil, electric insulation and an outer tube. The course of the mean temperature is shown graphically in the rod and the coolant along the EK-16 channel at a power of 1 kW. Also shown graphically are the hydrodynamic and heat characteristics of stand S III with the EK-16 measuring section. The location of NiCr-Ni microthermocouples on measuring rods is described. Vacuum distillation was used in measuring the sodium oxide content. Technological experiments confirmed that the reconstructed stand can be used for the research of temperature fields in BN-600 type reactors with desired accuracy.

8486 (WAPD-MRP—152) **Shippingport Atomic Power Station (PWR). Technical progress report, January 26, 1979-July 25, 1979.** (Bettis Atomic Power Lab., West Mifflin, PA (USA)). 1979. Contract EY-76-C-11-0014. 32p. Dep. NTIS, PC A03/MF A01.

The Shippingport Atomic Power Station operated at essentially full power until March 23, 1979, when a scheduled maintenance and testing shutdown began. During cold physics testing, the measured value of the flow coefficient of reactivity was higher than determined during previous testing. As a result the shutdown was extended to evaluate the flow coefficient of reactivity in more detail. The additional test data gave strong evidence that the flow reactivity effect is principally one of small core module radical displacements due to module bending and taking up of radial clearances. Evaluation of the thermal effects of the increased flow coefficient of reactivity resulted in changes to core protection setpoints and station operating procedures without changing core thermal criterial or allowable power. The revised setpoints were based on the conservative assumption that the flow coefficient of reactivity was three times the value measured during the test program. Additional testing has been scheduled to monitor the flow coefficient of reactivity periodically. During return of the station to power operation on May 24, 1979, a rubbing noise was detected internal to the main unit generator. The station was shut down to investigate the noise which was found to originate from the hydrogen circulator fan. After fan repairs were completed the Station returned to power operation on July 23, 1979.All other evaluated core test data taken during the shutdown and during core operations continue to show that the core operates in accordance with design predictions. During the periods of power operation only routine periodic maintenance was required to maintain the operational readiness of the plant.

8487 (SAN—0824-027-T1) **High quality tube-to-tubesheet joints - when, where and why.** Lillie, A.F. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). [nd]. Contract EY-76-C-03-0824-027. 12p. Dep. NTIS, PC A02/MF A01.

An autogeneous butt weld using the internal bore weld process is described. The weld is designed for the CRBR steam generator tubes to tubesheets which are fabricated of 2 1/2 Cr-1 Mo low alloy ferritic steel. As a precaution against in-service weld cracking, each weld is heat treated prior to inspection. (FS)

POWER REACTORS, AUXILIARY, MOBILE, PACKAGE, AND TRANSPORTABLE

REFER ALSO TO CITATION(S) 8757

8488 **Status report on nuclear reactors for space electric power.** Buden, D. (Univ of Calif, Los Alamos Sci Lab, NM). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 205-210(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The Los Alamos Scientific Laboratory is studying reactor power plants for space applications in the late 1980s and 1990s. The study is concentrating on high-temperature, compact, fast reactors that can be coupled with various radiation shielding systems and thermoelectric, dynamic, or thermionic electric power conversion systems, depending on the mission. Increased questions have been raised about safety since the COSMOS 954 incident. High orbits (above 400-500 nautical miles) have sufficient lifetimes to allow radioactive elements to decay to safe levels. The major proposed applications for satellites with reactors in Earth orbit are in geosynchronous orbit (19,400 nautical miles). In missions at geosynchronous oribt where orbital lifetimes are practically indefinite, the safety consideraons are negligible.

8489 **Improved thermionic power conversion system for space propulsion.** Hsieh, T.M.; Phillips, W.M. (Calif Inst of Technol, JPL, Pasadena). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 1917-1923(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A concept of an out-of-core thermionic nuclear electric power conversion system for 400 kWe power level is being investigated for space propulsion applications. Two key features distinguish the power system design from previous thermionic power conversion concepts. First, the thermionic converters are located outside a nuclear reactor with a neutron shield inserted to reduce the radiation level on the thermionic converter matrix. Second, multiple liquid-metal heat pipes are used exclusively for both thermal power transport (from the nuclear reactor to the thermionic converters) and waste heat removal (from the thermionic converters to the space radiator); no mechanical or electromagnetic pumps are involved. The system characteristics are compared to those of the in-core thermionic reactor system concept.

REGULATION AND LICENSING

REFER ALSO TO CITATION(S) 8543, 8650, 8690, 8691, 8692, 8693, 8694, 8695, 8696, 8714

8490 (INIS-mf—4767) **Operational safety experience reporting in the United States.** Hartfield, R.A. (Nuclear Regulatory Commission, Washington, DC (USA)). 1978. 10p. (CONF-781022—68). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

Licensees of nuclear power plants in the United States have many reporting requirements included in their technical specifications and the code of federal regulations, title 10. The Nuclear Regulatory Commisson receives these reports and utilizes them in its regulatory program. Part of this usage includes collecting and publishing this operating experience data in various reports and storing information in various data systems. This paper discusses the data systems and reports on operating experience published and used by the NRC. In addition, some observations on operating experience are made. Subjects included are the Licensee Event Report (LER) Data File, the Operating Unit Status Report (Gray Book), Radiation Exposure Reports, Effluents Reports, the Nuclear Plant Reliability Data System, Current Events, Bulletin Wrapups and Annual Summaries. Some of the uses of the reports and systems will be discussed. The Abnormal Occurence Report to the US Congress is described and discussed.

8491 (ORNL—5586) **Management plan for the Nuclear Standards Program.** (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 111p. Dep. NTIS, PC A06/MF A01.

This Management Plan was prepared to describe the manner in which Oak Ridge National Laboratory will provide technical management of the Nuclear Standards Program. The organizational structure that has been established within ORNL for this function is the Nuclear Standards Management Center, which includes the Nuclear Standards Office (NSO) already in existence at ORNL. This plan is intended to support the policies and practices for the development and application of technical standards in ETN projects, programs, and technology developments as set forth in a standards policy memorandum from the DOE Program Director for Nuclear Energy.

8492 (RDT-INDEX—(1-80)) **RDT Standards Index.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Jan 1980. Contract W-7405-ENG-26. 46p. RSO.

This issue covers June through December 1979 since there was not an October issue. The attached New Publications List identifies each standard, amendment, and/or revision that was published during this period.

ECONOMICS

8493 (PNL—2429) **ENFORM II: a calculational system for light water reactor logistics and effluent analysis.** Heeb, C.M.; Lewallen, M.A.; Purcell, W.L.; Cole, B.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 133p. Dep. NTIS, PC A07/MF A01.

ENFORM is a computer-based information system that addresses the material logistics, environmental releases and economics of light water reactor (LWR) operation. The most important system inputs consist of electric energy generation requirements, details of plant construction scheduling, unit costs, and environmental release factors. From these inputs the ENFORM system computes the mass balances and generates the environmental release information for noxious chemicals and radionuclides from various fuel cycle facilities (except waste disposal). Fuel cycle costs and electric power costs are also computed. All code development subsequent to 1977 is summarized. Programming instructions are provided for the modules that are comprised in the ENFORM system. ENGEN, a code that uses a generation schedule specified by the user and isotopic data generated by ORIGEN, has been developed to produce a scenario-specific data base. Other codes (ENMAT, ENRAD, etc) have been developed to use data base information to estimate radioactive and nonradioactive release information.

CONSTRUCTION AND OPERATION

REFER ALSO TO CITATION(S) 8645

FUEL CYCLE

REFER ALSO TO CITATION(S) 8464

8494 (CONF-791058—57) **Denatured fuel cycles.** Till, C.E. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, P 02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

This paper traces the history of the denatured fuel concept and discusses the characteristics of fuel cycles based on the concept. The proliferation resistance of denatured fuel cycles, the reactor types they involve, and the limitations they place on energy generation potential are discussed. The paper concludes with some remarks on the outlook for such cycles.

8495 (NUREG/CR—1041) **Fuel cycle cost projections.** Clark, L.L.; Chockie, A.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract EY-76-C-06-1830. 148p. Dep. NTIS, PC A07/MF A01.

This report estimates current and future costs associated with the light water reactor nuclear fuel cycle for both once-through and thermal recycle cases. Using a range of future nuclear power generating scenarios, process flows are developed for each segment of the nuclear fuel cycle. Capital and operating costs are estimated and are combined with the process flows to generate unit cost projections for each fuel cycle segment. The unit costs and process flows are combined in the NUCOST program to estimate fuel cycle power costs through the year 2020. The unit costs are also used to estimate the fuel costs of an individual model PWR and BWR.

PROCESS HEAT REACTORS

8496 (COO—4057-10) **Gas reactor international cooperative program interim report. HTR Multiplex market assessment.** Leeth, G.G.; Meyer, C.F. (General Electric Co., Santa Barbara, CA (USA). Center for Advanced Studies). Sep 1978. Contract EN-77-C-02-4057. 76p. Dep. NTIS, PC A05/MF A01.

The HTR Multiplex utilizes the HTR as an energy source to produce multiple forms of energy. A specific type of multiplex utilizing a high temperature chemical heat pipe (CHP) is examined. Forecasts of the US electric energy markets and industrial heat markets are developed for the 1995-2010 time period. Costs of multiplexes in these markets are compared to costs of the conventional forecast mix of electric generation systems and to costs of fluidized bed combustors in the industrial heat market. The comparisons are by National Electric Reliability Council (NERC) region. The major finding of the study is that a large potential US market exists for the HTR Multiplex in two segments of the electric and industrial heat markets. It is concluded that the HTR Multiplex can provide peaking and mid-range electricity plus industrial heat for one and two-shift operations at costs approximately 50 percent lower than available alternatives. This market is estimated to be at least 300 GW/sub t/ (about 7 quads per year) in the 1995 to 2010 time period.

8497 (GA-A—15685) **Design and application for a high-temperature nuclear heat source.** Quade, R.N. (General Atomic Co., San

Diego, CA (USA)). Nov 1979. Contract EY-76-C-03-0167-061. 37p. (CONF-791154—1). Dep. NTIS, PC A03/MF A01.

From Specialists meeting on process heat applications technology; Julich, F.R. Germany (27 Nov 1979).

The nuclear reactor designed for process heat has a power output of 842 MW(t), a core outlet temperature of 950°C (1742°F), and an intermediate helium loop to separate the heat source from the process heat exchangers. Steam-methane reforming is the reference process. As part of the development of a nuclear process heat system, a computer code, Process Heat Reactor Evaluation and Design, is being developed. This code models both the reactor plant and a steam reforming plant. When complete, the program will have the capability to calculate an overall mass and heat balance, size the plant components, and estimate the plant cost for a wide variety of independent variables.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 8471, 9449

8498 (CONF-791058—28) **Relative consistency of ENDF/B-IV and -V with fast-reactor benchmarks.** Yeivin, Y.; Wagschal, J.J.; Marable, J.H.; Weisbin, C.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The consistency of eleven selected fast-reactor and two neutron-field integral experiments with the ENDF/B-IV and -V libraries was examined by considering contributions to chi-square. Integral measurements least consistent with each given library were identified one at a time, and the particular cross sections which were significantly adjusted at each step were also identified. The results of this analysis demonstrate that, with respect to twelve out of the thirteen integral measurements considered, ENDF/B-V is a marked improvement over Version IV in the sense that (a) the integral data are significantly more consistent with Version V than with Version IV, (b) fewer cross sections need to be adjusted to achieve agreement between all the experimental data and the corresponding values calculated by Version V, and (c) the necessary adjustments are smaller.

8499 (LA—8036-PR, pp 22-28) **Effects of neutron absorption on decay heat.** LaBauve, R.J.; England, T.R.; Wilson, W.B. Sep 1979.

In Applied nuclear data research and development. Progress report.

Neutron absorption by fission products becomes important at high flux levels and long cooling times. A mathematical model of the effects of neutron absorption on decay heat was developed. To demonstrate the accuracy of an approximation using only two-nuclide chains, calculations for ^{235}U irradiated for 20,000 hours with thermal neutron fluxes of 10^{13} and 10^{14} n/cm^{2}s were performed. Results for total beta, total gamma, and total beta + gamma are presented. It is found that quite accurate absorption effects can be calculated by use of two-nuclide chains. 3 figures, 1 table. (RWR)

8500 (NUREG/CR—1003) **Generalized sensitivity theory for systems of coupled nonlinear equations.** Cacuci, D.G.; Weber, C.F.; Oblow, E.M.; Marable, J.H. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 105p. (ORNL/NUREG/TM—349). Dep. NTIS, PC A06/MF A01.

A general sensitivity theory is presented for treating problems characterized by systems of nonlinear equations with nonlinear responses. Frechet derivatives are used in both differential and variational approaches to derive appropriate adjoint equations and expressions for sensitivity functions. The two approaches are unified to from a complete operator viewpoint of sensitivity theory. Also presented is an alternative sensitivity formalism for systems of nonlinear matrix equations such as those arising from the application of numerical methods to many practical problems. This approach significantly enlarges the scope and versatility of sensitivity theory as it allows direct treatment of parameters which are purely of numerical methods origin. To demonstrate the usefulness and practical applications of both operator and matrix formalisms, a significantly nonlinear transient problem in fast reactor thermal-hydraulics is considered.

8501 (NUREG/CR—1054) **Transition boiling heat transfer in forced vertical flow. Final report, June 1978-June 1979.** Cheng, S.C.; Ragheb, H.; Ng, W.W.L.; Heng, K.T.; Roy, S.; Poon, K.T. (Ottawa Univ. (Canada). Dept. of Mechanical Engineering). Jun 1979. Contract W-31-109-ENG-38. 86p. (ANL—79-78). Dep. NTIS, PC A05/MF A01.

The study using high thermal capacity and inertia test sections to construct boiling curves for distilled water at atmospheric conditions has been continuing for the third year. In order to investigate the effect of heated surface thermal properties, boiling curves were generated from various composite test sections using one-dimensional three-layer model. A general empirical correlation including the effect of thermal properties as well as mass flux and inlet subcooling has been proposed. The earlier two-dimensional model, considering axial conduction, was modified and an application in Inconel-copper composite test section demonstrated. An investigation for the surface wetted area during transition boiling based on the electric probe study was conducted.

8502 (ORNL/TM—7096) **Perturbation and sensitivity theory for reactor burnup analysis.** Williams, M.L. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 178p. Dep. NTIS, PC A09/MF A01.

Perturbation theory is developed for the nonlinear burnup equations describing the time-dependent behavior of the neutron and nuclide fields in a reactor core. General aspects of adjoint equations for nonlinear systems are first discussed and then various approximations to the burnup equations are rigorously derived and their areas for application presented. In particular, the concept of coupled neutron/nuclide fields (in which perturbations in either the neutron or nuclide field are allowed to influence the behavior of the other field) is contrasted to the uncoupled approximation (in which the fields may be perturbed independently).

8503 (UJV—4490-A) **Multigroup fast reactor calculation by finite element method. IV. Computer programs.** Schmid, J.; Cermak, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Mar 1978. 17p. (In Czech). Available from Nuclear Research Institute, Rez, Czechoslovakia.

The methodology described uses the 1st order polynomial in a triangular shape element. Also the cyclic boundary condition on the symmetry axes ma.v be applied. A brief description is presented of two computer program packages.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 8532, 8831, 8851

8504 (BDX—613-2089R(Rev.)) **Hand deburring guide.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). Jul 1979. Contract EY-76-C-04-0613. 115p. Dep. NTIS, PC A06/MF A01.

Appropriate hand deburring techniques have always been difficult to define because of the infinite variety of part shapes, sizes, materials, and burr conditions. This guide, however, has been prepared to assist those responsible for hand deburring. The purpose of the guide is to define Bendix Kansas City burr specifications and inspection practices; to define the results of practical tests on hand deburring; to define some typical in-house practices; and to define the in-house tools available for this work.

8505 (IEA—512) **Planning of the steam generators for nuclear applications using optimization techniques.** Sakai, M.; Silvares, O.M. (Instituto de Energia Atomica, Sao Paulo (Brazil). Centro de Engenharia Nuclear). Jul 1978. 10p. (In Portuguese). Dep. NTIS (US Sales Only), PC A02/MF A01.

Procedure for the maximization of the net power of a nuclear power plant through the application of the optimal control theory of dynamic systems is presented. The problem is formulated in the steam generator which links the primary and the secondary cycle. The solution of the steam generator, optimization problem is obtained simultaneously with the heat balance in both primary and secondary cycle, through an iterative process. By this way the optimal parameters are obtained for the steam generator, the vapor and the cooling gas cycle.

8506 (UCRL—15103) **Detection of damage in structures from changes in their dynamic (modal) properties: a survey.** (Structural Measurement Systems, Inc., Santa Clara, CA (USA)). Sep 1979. Contract W-7405-ENG-48. 274p. Dep. NTIS, PC A12/MF A01.

Much of the newly developed technology in vibration measurement, digital signal processing and parameter identification can be utilized for monitoring the integrity of a variety of structural components in nuclear power plants. Although vibration levels in certain key components such as coolant pumps, turbo generators and the reactor core are currently monitored, simple checking of overall vibration levels is often not a sensitive enough indicator of impending failure in a structure. A more sophisticated approach to signal processing is examined which involves the identification of parameters describing the so called modes of vibration of a vibrating structure.

FUEL ELEMENTS

REFER ALSO TO CITATION(S) 8855

8507 (EGG-CDAP—5029) **Gas thermal conductivity (GASCON, GTHCON, GJUMP).** Hagrman, D.L. (Idaho National Engineering Lab., Idaho Falls (USA)). Oct 1979. Contract EY-76-C-07-1570. 55p. Dep. NTIS, PC A04/MF A01.

Revised models are presented for the thermal conductivity of initial and fission gases present in LWR fuel rods. The report will become part of an update to the Materials Properties (MATPRO) Handbook used in the fuel rod behavior modeling task performed at the INEL. The revision to the previous MATPRO gas thermal conductivity model replaces correlations based on smoothed values of thermal conductivity published by Gandhi and Saxena with correlations which incorporate new high temperature helium conductivity data. Also, uncertainty estimates have been provided and a consistent treatment of the effects of long mean free paths is employed (earlier versions of MATPRO contained an effective thermal conductivity model which considered only the mean free paths of helium and hydrogen).

8508 (IAEA-R—2050-F) **Failed fuel element detection by delayed neutrons using solid state track-etch technique. Final report for the period 1 July 1977 - 30 June 1978.** Boeck, E. (International Atomic Energy Agency, Vienna (Austria)). Oct 1978. 51p. Dep. NTIS (US Sales Only), PC A04/MF A01.

The activity sources in a reactor primary coolant are discussed and the neutron activity is calculated. In the experimental work a simple loop was constructed in a TRIGA MkII research reactor simulating the essential radioactivity features of a LWR primary circuit. With this loop the physical parameters of a failed fuel element detection system like location of foils, exposition time, etching conditions and temperature dependence was studied. It was demonstrated that delayed neutron detection with track-etch film detectors is feasible. From the various film materials investigated, the type Makrofol KG showed the best over-all properties taking into account the response to thermal neutron induced fission fragments and chemical, physical and mechanical properties. With visual track counting the neutron flux density should not exceed $5.10^4 cm^{-2} s^{-1}$ and the fluence should be kept below $1{,}5x10^8 cm^{-2}$. There is a linear dependence between track density and the thermal flux density with a standard deviation of +-15%. With automatic counting systems the flux density and fluence values could be increased and the standard deviation reduced to some +-5%. It is proposed that the track-etch film technique could be a back-up system for an independent delayed neutron control providing also a permanent record.

8509 (INIS-mf—4865) **Safety criteria related to microheterogeneities in LWR mixed oxide fuels.** Renard, A.; Mostin, N. (Societe Belge pour l'Industrie Nucleaire, Brussels). 1978. 11p. (CONF-781022—83). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

The main safety aspets of PuO_2 microheterogeneities in the pellets of LWR mixed oxide fuels are reviewed. Points of interest are studied, especially the transient behaviour in accidental conditions and criteria are deduced for use in the specification and quality control of the fabricated product.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 9320

SITING

REFER ALSO TO CITATION(S) 9045

RADIOACTIVE EFFLUENTS

8510 (BNL—26970) **Critique of source term and environmental measurement at Three Mile Island.** Hull, A.P. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 20p. (CONF-791037—14). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

The most serious malfunction to date at an operating power reactor in the US occurred at Unit 2 of the Three Mile Island Nuclear Power Station (TMI) at 0400 est on March 28, 1979. Subsequently, between 3X and 10 x 10^6 Ci of radiogases (principally ^{133}Xe) were released to the atmosphere from the plant vent in decreasing concentrations over the next few weeks, accompanied by abut 10 Ci of ^{131}I. During this period, the plant's typical effluent monitors and field radiation monitoring program were unable to supply prompt and reliable radiological information. In order to provide a sufficient radioanalytical capability for the large number of in-plant and environmental samples (air, water, soil, vegetation and milk) which were obtained, the existing on-site facilities were augmented by mobile laboratories. The laboratory facilities of the Bureau of Radiological Health (BRH-PA) of the Pennsylvania Department of Environmental Conservation were supplemented by a nearby temporary facility for gamma analysis set up by the Department of Energy (DOE). Many environmental samples, principally of milk, were also transported to more remotely established radioanalytical laboratories of state and federal agencies.

8511 (SGAE—2950) **Effects of low doses at the operation of nuclear power plants.** Mueck, K.; Wawra, E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Jul 1978. 92p. (In German). (AR—16/78; BL—231/78). Dep. NTIS (US Sales Only), PC A05/MF A01.

In connexion with the debate on nuclear energy again and again attempts are found to threaten the public with incorrect or dramatically exaggerated statements about the effect of low-level-radiation by nuclear technology. Thereby a wrong impression in parts of the population about the dangers of low-level-radiaton doses arose. This paper shall help to clarify some of the misunderstandings and describe the present state of knowledge in this field in a way also understandable by the interested layman.

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 8478, 8481, 8482, 8529, 8534, 8560, 9453, 9457

8512 (CONF-791051—16) **Analysis of EBR-II blanket dosimetry.** Meneghetti, D.; Ebersole, E.R.; Kucera, D.A.; Rempert, R.H. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 11p. Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Comparisons of reaction-rate calculations with absolute dosimetry measurements in the EBR-II blanket are made for ^{235}U/sub f/, ^{239}Pu/sub f/, ^{238}U/sub f/, and ^{238}U/sub c/ reactions.

8513 (EGG-LO-MR—79-001) **LOFT monthly progress report for October 1979.** Kaufman, N.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1979. Contract EY-76-C-07-1570. 91p. Dep. NTIS, PC A05/MF A01.

During October, plant work continued ahead of schedule toward performance of LOFT Experiment L3-1 in late November. L3-1 will be the first LOFT nuclear test of a small break. Specifically, the reactor will be operated at a power level of 50 megawatts just before initiation of a small break in the inlet (cold) leg. The break size has been selected in conjunction with emergency core cooling system (ECCS) flow to result in a prolonged and continued depressurization of the plant. That depressurization will end when the pressure reaches that of the low-pressure ECCS (about 200 psi). October costs reflect manpower levels slightly greater than budgeted and significant uncosted material. Also included are the first costs associated with the Nuclear Regulatory Commission(NRC) purchase of inventories of special process spare parts.

8514 (EGG/LTR—1111-64) **LOFT Zircaloy cladding collapse deformation tests.** Olsen, C.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 12 Oct 10079. Contract EY-76-C-07-1570. 19p. Dep. NTIS, PC A02/MF A01.

Scoping tests were performed to determine at high pressures and high temperatures, the minimum time required to deform the cladding and at high temperatures and low pressures to determine the effect of Zircaloy creep for long times on cladding deformation.

8515 (ETEC-TDR—79-10) **Dynamic testing of a prototypical FFTF piping system.** Stearns, J.D.; Onesto, A.T.; Hunter, R.G. (Rockwell International Corp., Canoga Park, CA (USA). Energy Technology Engineering Center). 28 Sep 1979. Contract EY-76-C-03-0700. 257p. AT.

Dynamic tests were conducted on a fully insulated one-inch diameter prototypical FFTF pipe system to study the behavior of the pipe system and support structure during vibrational loading. Tests were conducted with both rigid struts for reference and mechanical snubbers. Test setup and sine sweep tests, simulated seismic tests, and a sine dwell to failure are described. Selected data are included in the Appendices.

8516 (HEDL—6629) **FFTF preproduction mechanical snubber qualification test program for Westinghouse/Hanford.** (Hanford Engineering Development Lab., Richland, WA (USA)). 10 Nov 1978. Contract EY-76-C-14-2170. 384p. AT.

Performance testing data are presented for FFTF reactor seismic restraints.

8517 (HEDL-SA—1795) **FFTF status and test results.** Noordhoff, B.H. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1979. Contract EY-76-C-14-2170. 219p. (CONF-7904117—1). Dep. NTIS, PC A10/MF A01.

From American Nuclear Society meeting; Los Angeles, CA, USA (19 Apr 1979).

Portions of document illegible.

A general description of the FFTF is presented concerning the construction progress; status of startup and selected startup test results; and planned experiment program during and subsequent to the startup testing program. The FFTF is a 400 MWt, sodium cooled test reactor plant consisting of a fast-neutron reactor fueled by mixed plutonium oxide-uranium oxide fuel elements, three independent heat transport loops, extensive instrumentation, fuel handling equipment, and auxiliary systems which support the main reactor and cooling systems. The FFTF contains no steam generators, electrical generating equipment, or breeding blankets. Heat generated in the reactor is released to the ambient atmosphere by twelve large sodium-to-air heat exchangers.

8518 (HEDL-SA—1850) **Design and construction of the Fuels and Materials Examination Facility.** Burgess, C.A. (Hanford Engineering Development Lab., Richland, WA (USA)). 15 Nov 1979. Contract EY-76-C-14-2170. 32p. (CONF-791103—59). Dep. NTIS, PC A03/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Final design is more than 85 percent complete on the Fuels and Materials Examination Facility, the facility for post-irradiation examination of the fuels and materials tests irradiated in the FFTF and for fuel process development, experimental test pin fabrication and supporting storage, assay, and analytical chemistry functions. The overall facility is generally described with specific information given on some of the design features. Construction has been initiated and more than 10% of the construction contracts have been awarded on a fixed price basis.

8519 (HEDL-SA—1852) **Sensor for measurement of fuel rod gas pressure during loss-of-fluid-tests.** Billeter, T.R. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1979. Contract EY-76-C-14-2170. 8p. Dep. NTIS, PC A02/MF A01.

Qualification tests have been conducted of a measurement system for determining the pressure of certain fuel rods in the loss-of-fluid-test (LOFT) reactor. Because of physical size (0.35-in. OD by 5.5-in length) and operational characteristics, an eddy current device was selected as the most promising measurement transducer for the application. The sensor must operate at pressure up to 17.2 MPa (2500 psig) and at temperatures up to 800°F. During the reactor transient caused by loss of coolant flow, sensor temperature and applied pressure will vary rapidly and significantly. Consequently, qualification tests included subjection of the sensor to rapid depressurization, temperature transients, and blowdowns in an autoclave, as well as to calibrations and various slow temperature cycles.

8520 (HEDL-SA—1854FP) **Integrated quality status and inventory tracking system for FFTF driver fuel pins.** Gottschalk, G.P. (Hanford Engineering Development Lab., Richland, WA (USA)). Nov 1979. Contract EY-76-C-14-2170. 14p. (CONF-791117—18). Dep. NTIS, PC A02/MF A01.

From ANS topical conference; Kiawah Island, SC, USA (26 Nov 1979).

An integrated system for quality status and inventory tracking of Fast Flux Test Facility (FFTF) driver fuel pins has been developed. Automated fuel pin identification systems, a distributed computer network, and a data base are used to implement the tracking system.

8521 (HEDL-SA—1860) **Creep relaxation of fuel pin bending and ovalling stresses.** Chan, D.P.; Jackson, R.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1979. Contract EY-76-C-14-2170. 27p. (CONF-791205—16). Dep. NTIS, PC A03/MF A01.

From ASME winter annual meeting; New York, NY, USA (2 Dec 1979).

Analytical methods for calculating fuel pin cladding bending and ovalling stresses due to pin bundle-duct mechanical interaction taking into account nonlinear creep are presented. Calculated results are in close agreement with finite element results by MARC-CDC program. The methods are used to investigate the effect of creep on the FTR fuel cladding bending and ovalling stresses. It is concluded that the cladding of 316 SS 20% CW and reference design has high creep rates in the FTR core region to keep the bending and ovalling stresses to low levels.

8522 (HEDL-SA—1900) **2200°C fuel centerline thermocouples for the LOFT program.** Cannon, C.P.; Lunghofer, J. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1979. Contract EY-76-C-14-2170. 16p. (CONF-791037—12). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

The technology as well as commercial suppliers have been developed for high temperature thermocouples for the Loss-of-Fluid-Test (LOFT) program. Two types of thermocouples were developed and tested. Model B units contained a 1/16-inch OD 24-inch long Mo/Re sheath probe and were capable of temperature measurement to 1550°C. Model A units contained a 1/16-inch OD 41-inch long W/Re-augmented sheath probe and were capable of temperature measurement to 2200°C.

8523 (HEDL-SA—1942-FP) **Solid state track recorder measurements in the poolside critical assembly.** Ruddy, F.H.; Gold, R.; Roberts, J.H. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 16p. (CONF-791051—11). Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Fission rate measurements using solid state track recorders (SSTR) have been performed at the PCA. A schematic representation of a cross-section of the PCA is shown. Fission rates were measured in the pressure vessel simulator at the T/4, T/2 and 3T/4 positions and in the void box (VB). SSTR measurements were carried out with ^{232}Th, ^{235}U (bare and cadmium covered), ^{238}U and ^{237}Np fissionable deposits. Midplane only measurements were carried out for ^{235}U and ^{237}Np, while 5 axial locations at 1/4T and 1/2T and 3 axial locations at 3/4T and in the VB were sampled for ^{232}Th and ^{238}U. The HEDL SSTR fission rate measurements reported herein for both configurations together with NBS and CEN/SCK fission chamber measurements will be used to establish absolute and relative fission reaction rates, and ratios for the PCA pressure vessel Benchmark Facility.

8524 (INDC(RUM)—9/GV) **Comparison of some multigroup nuclear data sets on existing fast neutron assemblies.** Cuculeanu, V.; Mocioiu, D.; Constantinescu, D. (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Jan 1979. 25p. Dep. NTIS (US Sales Only), PC A03/MF A01.

In the present paper some multigroup nuclear data sets are analysed in terms of the neutronic parameters of some existing fast assemblies.

8525 (LA-UR—79-2686) **Measurement of the neutron spectrum of the Big Ten critical assembly by lithium-6 spectrometry.** De Leeuw-Gierts, G.; De Leeuw, S.; Hansen, G.E.; Helmick, H.H. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium); Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6p. (CONF-791051—4). Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

The central neutron-flux spectrum of the Los Alamos Scientific Laboratory's critical assembly, Big Ten, was measured with a ^{6}Li spectrometer and techniques developed at the Centre d'Etude de L'Energie Nucleaire, Mol, as part of an experimental program to establish the characteristics of Big Ten.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 8510, 8637, 8642

8526 (ANL—79-72) **ALICE: a hybrid Lagrangian-Eulerian code for calculating fluid-structure interaction transients in fast-reactor containment.** Chu, H.Y. (Argonne National Lab., IL (USA)). Aug 1979. Contract W-31-109-ENG-38. 59p. Dep. NTIS, PC A04/MF A01.

This report describes a reactor-containment code, ALICE, which uses an arbitrary Lagrangian-Eulerian method to describe the coolant motion, together with a Lagrangian method to analyze the response of the containment vessel and other solid media inside a reactor containment. The finite-difference formulation used to approximate the governing equations for the motion of the coolant can be solved in either an explicit or an implicit scheme; the finite-element formulation used to approximate the governing equations for the containment vessel and other solid media can be performed only in the explicit scheme. Thus, the ALICE code can perform two types of coupling calculations for the fluid and structure (implicit-explicit and explicit-explicit). The code is generalized so that it can apply to problems either in a two-dimensional Cartesian or in a two-dimensional cylindrical-coordinate system.

8527 (CONF-790902—3) **Impact of advanced systems on LMFBR accident analysis code development.** Dunn, F.E.; Kyser, J.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 12p. Dep. NTIS, PC A02/MF A01.

From Impact of advanced systems on scientific computations; Livermore, CA, USA (12 Sep 1979).

In order to investigate the ability of an advanced computer, using currently available software, to handle large LMFBR accident analysis codes, the SAS3D code has been run on the NCAR CRAY-1. SAS3D is a large code (56,000 Fortran cards) using many different physical models and numerical algorithms, no one of which dominates the computing time. Even though SAS3D was developed on IBM computers, remarkably little effort was required to run it on the CRAY-1. Making limited use of the CRAY-1 vector capabilities, it runs a factor of 2.5 to 4 times faster on the NCAR CRAY-1 than on the ANL IBM 370-195. With minor modifications, an additional 20 to 30% speed improvement on the CRAY-1 is achieved. In the current process of completely re-writing SAS3D to make SAS4A, much of the coding is being vectorized for the CRAY-1 without sacrificing IBM, CDC 7600, or UNIVAC performance and portability. An initial SAS4A test case runs a factor of 7.1 faster on the CRAY-1 than on the IBM 370-195.

8528 (CONF-791123—3) **Behavior of deep flaws in a thick-wall cylinder under thermal shock loading.** Cheverton, R.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 24p. Dep. NTIS, PC A02/MF A01.

From Water reactor safety meeting; Washington, DC, USA (5 Nov 1979).

Behavior of inner-surface flaws in thick-walled vessels was studied in a 991-mm OD x 152 mm wall x 1220 mm length cylinder with toughness properties similar to those for HSST Plate. The initial temperature of 93°C and a thermal shock medium of liquid nitrogen (-197°C) were employed. The initial flaw selected was a sharp, 16 mm deep, long (1220 mm) axial crack. Crack arrest methodology was shown to be valid for deep flaws under severe thermal shock. (FS)

8529 (CONF-7906144—1) **Results of the PBF/LOFT Lead Rod Test Series.** Varacalle, D.J. Jr.; Garner, R.W.; Hobbins, R.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 19p. Dep. NTIS, PC A02/MF A01.

From Enlarged halden program group meeting; Hanko, Norway (17 Jun 1979).

The PBF/LOFT Lead Rod (PBF/LLR) Test Series consisted of four sequential, nuclear blowdown experiments (Test LLR-3, LLR-5, LLR-4, and LLR-4A). The primary objective of the test series was to evaluate the extent of mechanical deformation that would be expected to occur to low pressure (0.1 MPa) light water reactor design fuel rods subjected to a series of nuclear blowdown tests, and to determine if subjecting deformed fuel rods to subsequent testing would result in rod failure. The extent of mechanical deformation (buckling, collapse, or waisting of the cladding) was evaluated by comparison of cladding temperatue versus system pressure response with out-of-pile experimental data and by posttest visual examinations and cladding diametral measurements.

8530 (DOE/TIC—11023) **Post-accident cleanup of radioactivity at Three Mile Island.** Brooksbank, R.E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

Plant schematics, equipment modifications, radioactivity water processing procedures, and radioactivity levels at the Three Mile Island-2 reactor are presented.

8531 (EGG-TFBP—5010) **Review of FRAP-T4 performance based on fuel behavior tests conducted in the PBF.** Charyulu, M.K. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1979. Contract EY-76-C-07-1570. 93p. Dep. NTIS, PC A05/MF A01.

The ability of the Fuel Rod Analysis Program - Transient (FRAP-T), a computer code developed at the Idaho National Engineering Laboratory to calculate fuel rod behavior during transient experiments conducted in the Power Burst Facility, is discussed. Fuel rod behavior calculations are compared with data from tests performed under postulated RIA, LOCA, and PCM accident conditions. Physical phenomena, rod damage, and damage mechanisms observed during the tests and not presently incorporated into the FRAP-T code are identified.

8532 (GKSS—78/E/44) **CORAN - a modular code to analyze the containment performance during LOCAs, taking heat sinks into account.** Schwan, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1978. 30p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

For accompanying analytical work on research projects in the field of containment performance during reactor accidents the code CORAN (Containment Response Analysis) has been developed, other available containment codes having proved to be little flexible and much computing time consuming. This basic version of CORAN describes the thermodynamic behavior of the containment during LOCA, structures being taken into account as heat sinks. Special problem formulations with respect to the licensing procedure may be added without difficulty because of the modular code structure.

8533 (HEDL-SA—1835) **Confidence level in the calculations of HCDA consequences using large codes.** Nguyen, D.H.; Wilburn, N.P. (Hanford Engineering Development Lab., Richland, WA (USA)). 20 Apr 1979. Contract EY-76-C-14-2170. 7p. (CONF-791103—61). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The probabilistic approach to nuclear reactor safety is playing an increasingly significant role. For the liquid-metal fast breeder reactor (LMFBR) in particular, the ultimate application of this approach could be to determine the probability of achieving the goal of a specific line-of-assurance (LOA). Meanwhile a more pressing problem is one of quantifying the uncertainty in a calculated consequence for hypothetical core disruptive accident (HCDA) using large codes. Such uncertainty arises from imperfect modeling of phenomenology and/or from inaccuracy in input data. A method is presented to determine the confidence level in consequences calculated by a large computer code due to the known uncertainties in input invariables. A particular application was made to the initial time of pin failure in a transient overpower HCDA calculated by the code MELT-IIIA in order to demonstrate the method. A probability distribution function (pdf) for the time of failure was first constructed, then the confidence level for predicting this failure parameter within a desired range was determined.

8534 (IEA-DT—063) **Analysis of criticality accidents in the zero power reactor of Instituto de Energia Atomica, Brazil.** Granziera, M.R. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jul 1978. 61p. (In Portuguese). Dep. NTIS (US Sales Only), PC A04/MF A01.

An analysis of criticality accidents in the zero power reactor of Instituto de Energia Atomica, Brazil, is presented.

8535 (INIS-mf—4769) **Decommissioning study for nuclear power plants with lightwater reactors. First results.** Watzel, G.V.P.; Essmann, J.; Lukacs, G.; Thalmann, G. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Biblis (Germany, F.R.). Betriebsverwaltung). 1978. 9p. (CONF-781022—72). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

A study under way concerning decommissioning nuclear power plants with LWR's is reported. The study is ordered by the association of German utilities (VDEW) and performed by Nuclear Ingenieur Service Corp. (NIS). First results concerning radioactivity inventory, amount of wastes, review of techniques, relevant experiences are presented.

8536 (INIS-mf—4773) **Cassandre: A 2D multigroup diffusion Benchmark code for fast reactors power excursions analysis.** Bardiaux, M.; Devooght, J.; Mund, E.; Saragossi, I. (Brussels Univ. (Belgium)); Dugnoille, P.; Goldwasser, M.; Joly, J.; Siebertz, A. (Brussels Univ. (Belgium); Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1978. 13p. (CONF-781022—64). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

CASSANDRE uses a four group 2D diffusion model with finite elements up to quintic order. Time dependence involves a generalization of the qasistatic approximation with a different amplitude function for each group. The coupled shape and amplitude equations are cast into integral form and solved iteratively using a Newton - SOR algorithm. A simplified thermohydraulics feedback is incorporated. A great number of parametric studies involving different time steps and number of Newton iterations show that power transients accuracy near prompt critical may be strongly affected by reactivity and shape function convergence.

8537 (INIS-mf—4774) **Light water reactor safeguards system evaluation.** Varnado, G.B.; Ericson, D.M. Jr.; Bennett, H.A.; Hulme, B.L.; Daniel, S.L. (Sandia Labs., Albuquerque, NM (USA)). 1978. 12p. (CONF-781022—71). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

A methodology for assessing the effectiveness of safeguards systems was developed in this study and was applied to a typical light water reactor plant. The relative importance of detection systems, barriers, response forces and other safeguards system components was examined in extensive parameter variation studies.

8538 (INIS-mf—4775) **Protection against external impacts and missiles - Load assumption and effects on the plant design of a 1300 MW PWR-Plant.** Gremm, O.; Orth, K.H. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). 1978. 8p. (CONF-781022—66). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

The load assumptions and effects of the external impacts are given. The fundamental properties of the KWU standard design according to these impacts and the consequences for the engineering safeguards are explained. The protection against external impacts includes the protection against all external missiles. The basic measure of protection against internal missiles is the strict separation of redundancies.

8539 (INIS-mf—4776) **Seismic reevaluation of existing nuclear power plants.** Hennart, J.C. (Westinghouse Electric Nuclear Energy Systems Europe (WENESE), Brussels (Belgium)). 1978. 8p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The codes and regulations governing Nuclear Power Plant seismic analysis are continuously becoming more stringent. In addition, design ground accelerations of existing plants must sometimes be increased as a result of discovery of faulting zones or recording of recent earthquakes near the plant location after plant design. These new factors can result in augmented seismic design criteria. Seismic reanalysis of the existing Nuclear Power Plant structures and equipments is necessary to prevent the consequences of newly postulated accidents that could cause undue risk to the health or safety of the public. This paper reviews the developments of seismic analysis as applied to Nuclear Power Plants and the methods used by Westinghouse to requalify existing plants to the most recent safety requirements.

8540 (INIS-mf—4777) **Quantitative techniques for nuclear plant safety assessment and design.** Moss, T.J. (Australian Atomic Energy Commission, Coogee). 1978. 9p. (CONF-781022—70). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

The increasing possibility for using quantitative risk and reliability criteria in the siting and licensing of nuclear plant raises various problems for those who must decide if and how such requirements will be incorporated into the regulatory review framework. The analysis of a system which raises important issues and problems related to the use of quantitative risk and reliability methods and requirements in the design assessment process is discussed. In particular, the development of a fast fault tree method useful for the evaluation of large trees is discussed and the comparative performance of the method with well-known codes presented. It is suggested that the method may lend itself to further improvement in terms of computing efficiency and a role for an ultra fast fault tree resolution method capabie of dealing with large fault trees is discussed.

8541 (INIS-mf—4862) **Safety study. The Clinch River Breeder Reactor Plant.** Piper, H.B.; Leaver, D.E.; Wood, P.J. (Project Management Corp., Oak Ridge, TN (USA)). 1978. 9p. (CONF-781022—84). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

A risk assessment has been performed to provide a realistic evaluation of the risk to the public from the Clinch River Breeder Reactor Plant (CRBRP), to place that risk in perspective relative to other societal risks, and to provide a basis for assessing the comparability of the risk from the CRBRP with risks associated with previously licensed US reactors. The assessment formally and systematically evaluated the CRBRP risk and showed that the risk associated with postulated accidents of the CRBRP is small when compared with non-nuclear risks to which the local population is already exposed, and that CRBRP risks are comparable to those from light-water reactors (LWR's) of the current generation as characterized in the Rasmussen Study.

8542 (INIS-mf—4863) **Common mode failures in redundancy systems.** Watson, I.A.; Edwards, G.T. (National Centre of Systems Reliability, Culcheth (UK)). 1978. 10p. (CONF-781022—82). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

Difficulties are experienced in assessing the impact of common mode failures on the reliability of safety systems. The paper first covers the investigation, definition and classification of CMF based on an extensive study of the nature of CMF. This is used as a basis for analysing data from nuclear reactor safety systems and aircraft systems. Design and maintenance errors are shown to be the prdominant cause of CMF. The analysis has laid the grounds for work on relating CMF modelling and defences.

8543 (INIS-mf—4867) **Licensing evaluation of CANDU-PHW nuclear power plants relative to U.S. regulatory requirements.** van Erp, J.B. (Argonne National Lab., IL (USA)). 1978. 12p. (CONF-781022—85). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

Differences between the U.S. and Canadian approach to safety and licensing are discussed. U.S. regulatory requirements are evaluated as regards their applicability to CANDU-PHW reactors; vice-versa the CANDU-PHW reactor is evaluated with respect to current Regulatory Requirements and Guides. A number of design modifications are proposed to be incorporated into the CANDU-PHW reactor in order to facilitate its introduction into the U.S. These modifications are proposed solely for the purpose of maintaining consistency within the current U.S. regulatory system and not out of a need to improve the safety of current-design CANDU-PHW nuclear power plants. A number of issues are identified which still require resolution. Most of these issues are concerned with design areas not (yet) covered by the ASME code.

8544 (INIS-mf—4869) **Method for studying common mode failures. Application to HTGR core auxiliary cooling system.** Duchemin, B.; Kalli, H.; Lanore, J.M.; de Villeneuve, M.J.; Carnino, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1978. 6p. (CONF-781022—79). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

A computational method to deal with common mode failures for a fault tree reliability calculation is proposed; its interest is shown in the example of a High Temperature Gas Reactor Core Auxialiary Cooling System.

8545 (INIS-mf—4871) **Possibilities of restart and delayed afterheat removal in loss of forced cooling-accidents for pebble-bed HTR.** Doehler, J.; Jahn, W.; Muench, E.; Rehm, W.; Roethig, K.D.; Talarek, H.D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). 1978. 11p. (CONF-781022—78). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

The prolonging effects on counter measures in heat-up accidents of HTR of recent results of experiments concerning failure limits of coated particles and heat conductivity in a pebble-bed are described. This comprises the possibility of restarting after heat removal after having failed and effects on the reactivity balance of the system.

8546 (INIS-mf—4872) **Reliability analysis for the safety injection (SI) system of the Doel I - II power plant in case of a LOCA.** de Meester, P.; Poucet, A. (Louvain Univ. (Belgium)). 1978. 7p. (CONF-781022—80). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

An assement is made for the failure probability of the safety injection system of the Doel power plant. The SI system is composed of three subsystems: high pressure, low pressure and accumulator system. For each subsystem a fault tree is constructed and these fault trees are evaluated by a computer code which calculates the mean system failure probability and the error bounds.

8547 (JAERI-M—7695) **LFTPLT7 - LOFT plotter program.** Soda, K.; Wada, Y.; Otsubo, N. (Japan Atomic Energy Research Inst., Tokyo). May 1978. 30p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

The plotter program has been developed for LOFT data analysis and comparison with calculated results of RELAP4 Mod2, RELAP4 Mod5 and ALARM-P1. It is capable of multiple plotting of data and calculated results and calculation with experimental data as well as calculated results and plotting. It is also applicable to any experimental data if the written format is as specified.

8548 (JAERI-M—7737) **ROSA-II test data report, 13. Improved ECCS injection method (runs 502, 505, 506, 507).** (Japan Atomic Energy Research Inst., Tokyo). Jul 1978. 168p. (In Japanese). Dep. NTIS (US Sales Only), PC A09/MF A01.

Results of the ROSA-II test simulating a loss-of-coolant accident (LOCA) in a PWR are presented, including test conditions and interpretations of phenomena observed in test runs 502, 505, 506 and 507. Development tests were performed to find a more effective ECCS injection method than the existing one based on cold leg injection. A combined injection of hot water into upper plenum in early stage of blowdown and subsequent cold water into lower plenum is the most effective method for a cold leg break. A hot leg injection of a low pressure injection system is effective for direct core cooling and early reflooding. The generalization for actual reactors will require analyses with a reliable code.

8549 (JAERI-M—7791) **Preliminary analysis of ROSA-III experiment. III.** Kitaguchi, H.; Suzuki, M.; Sobajima, M.; Shiba, M. (Japan Atomic Energy Research Inst., Tokyo). Aug 1978. 122p. (In Japanese). Dep. NTIS (US Sales Only), PC A07/MF A01.

Preliminary analysis of ROSA-III experiment has been made with the detailed dimensions fixed, using RELAP-4J code. Effects of

the parameters on thermohydraulic behavior of coolant were examined, following on results of the previous analysis. For break conditions, full break at recirculation pump suction was mainly examined, and also other breaks such as in pump discharge-side, main steam line and small break at recirculation pump suction. Following are the conclusions. Water injected into the upper plenum causes condensation-depressurization and the water flowing down to the core decreases. The flow rate in the core should be measured in the ROSA-III test to confirm the predicted phenomena. Effects of the safety-relief valve actuated in small breaks must be considered; measurement of flow rate in the safety-relief line is necessary in ROSA-III test. Analysis with maximum heat flux rods must be made in the future, in addition to the present pre-analysis using average heat flux rods.

8550 (JAERI-M—7808) **Flow reduction transient burnout data in an annular test section. Transient flow boiling under atmospheric pressure. V.** Kuroyanagi, T.; Iwamura, T. (Japan Atomic Energy Research Inst., Tokyo). Aug 1978. 173p. (In Japanese). Dep. NTIS (US Sales Only), PC A09/MF A01.

Burnout phenomena in flow reduction transients have been studied in up-flow of water in a vertical annular test section under atmospheric pressure. The gap between the electrically heated stainless steel tube and the outer glass shroud is 2.0 mm or 1.4 mm, and the heated tube is outer diameter 10 mm, wall thickness 1 mm and length 800 mm. Experimental conditions are: heat flux = 0.65 -- 1.36 x 10^6 kcal/hm^2; inlet water temperature = 30 -- 76°C; initial mass velocity = 2.4 -- 6.0 x 10^6 kg/hm^2; flow reduction time = 0.1 -- 68 sec; and flow reduction rate = 0.29 -- 752 cm/sec/sec. The transient data of flow rate, pressures and wall temperatures, and photographes are presented.

8551 (LBL—10017) **Evaluation of the effects of detonation in a spherical bomb.** Kurylo, J.; Oppenheim, A.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-EBG-48. 17p. (CONF-790828—3). Dep. NTIS, PC A02/MF A01.

From 7. international colloquium on gas-dynamics of explosions and reactive systems; Gottingen, F.R. Germany (20 Aug 1979).

An analysis is presented of the time-dependent pressure forces and impulse loadings on the walls of the hemispherical dome of a nuclear reactor pressure vessel arising from a centrally ignited hydrogen-oxygen detonation. Investigated in this context are the effects of richness of the detonable gas mixture as well as those due to the inclusion of water vapor. In the analysis the gas mixture was treated as a perfect gas, and the partial differential equations governing the gasdynamic flow were integrated using the CLOUD CODE - a finite-difference technique set in Lagrangian coordinates and incorporating the smoothing action of artificial viscosity. The most interesting results pertain to the ringing of pressure pulses at the walls. Their frequency is quite uniform, and their pressure peaks, at levels significantly higher than that of combustion at constant volume, decay at a negligible rate.

8552 (NRPB-R—73) **Influence of the physico-chemical form of the aerosol on the radiological consequences of notional accidental releases of radioactivity from a fast breeder reactor.** Kelly, G.N.; Jones, J.A.; Simmonds, J.R. (National Radiological Protection Board, Harwell (UK)). Jan 1979. 147p. Dep. NTIS (US Sales Only), PC A08/MF A01.

The radiological consequences of a wide range of notional accidental releases from a 1300 MW(e) LMFBR (Liquid Metal-cooled Fast Breeder Reactor) were assessed in a study published by the National Radiological Protection Board (NRPB) in 1977. In that study representative values were in general adopted for each of the important parameters while recognising that in reality they could vary considerably. The present study is concerned with the sensitivity of the predicted consequences to the physico-chemical form of the released aerosol. Of particular interest is the importance of a mixed sodium-transuranium element aerosol which may be formed in accidental releases of activity from sodium cooled FBRs. Two significant findings emerge from the study. First the predicted consequences in general are relatively insensitive to the range of physico-chemical forms analysed. For generic assessments therefore it is sufficient to assume the properties of the aerosol adopted in the initial study (1 μm AMAD and each element in the oxide form); the exception concerns the estimation of the incidence of early morbidity, and to a lesser extent early mortality, but only for a limited range of release composition. The second finding is that the radiological consequences are not, contrary to what might have been expected, significantly increased for the release of a mixed sodium-element aerosol.

8553 (NUREG/CR—0947) **Steam explosion efficiency studies.** Buxton, L.D.; Benedick, W.B. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 62p. (SAND—79-1399). Dep. NTIS, PC A04/MF A01.

A series of 48 intermediate-scale steam explosion experiments was recently completed. The purpose of the experiments was to investigate the efficiency of converting the thermal energy of a melt into mechanical work during a reasonably large steam explosion. The melts used were 1 to 27 kg quantities of an iron/alumina mixture. The melts were poured into an open tank of water. The primary parameters varied were water quantity, melt quantity, and water temperature. Spontaneous explosions occurred in most of the experiments with several experiments exhibiting multiple explosions. Some explosions were artificially triggered with no observed enhancement in efficiency. Pressurizations with peak amplitudes of 5 to 10 MPa and a few milliseconds duration were usually obtained near the tank walls. Higher amplitude pressure spikes of very short duration were sometimes seen on the pressure traces.

8554 (NUREG/CR—1062) **LMFBR Aerosol Release and Transport Program. Quarterly progress report, April-June 1979.** Kress, T.S.; Wright, A.L. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 50p. (ORNL/NUREG/TM—354). Dep. NTIS, PC A03/MF A01.

This program is designed to investigate radionuclide release and transport from LMFBRs for reactor events of severity up to and including hypothetical core-disruptive accidents (HCDAs). Program topics discussed include recent capacitor discharge vaporization (CDV) tests in the Fuel Aerosol Simulant Test (FAST)/Containment Research Installation-III (CRI-III) facility, including underwater tests in the FAST vessel and underwater and vacuum tests in the CRI-III vessel; preliminary results from three Nuclear Safety Pilot Plant (NSPP) uranium oxide aerosol tests using the dc plasma metal-oxygen torch as an aerosol generator; results from CRI-III sodium oxide aerosol tests using the liquid-metal-spray sodium oxide aerosol generator; results from the normalization of the spiral-duct centrifuge calibration at different speeds; and the presentation of possible methods for calculating the rise in water temperature at the bubble vapor-liquid interface in FAST water experiments.

8555 (NUREG/CR—1080) **Water reactor safety programs. Quarterly technical progress report, July-September 1979.** Ybarrondo, L.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1979. Contract EY-76-C-07-1570. 54p. (EGG—2003). Dep. NTIS, PC A04/MF A01.

Water reactor research performed by EG and G Idaho, Inc., during July through September 1979 is reported. Two tests were evaluated by the Semiscale Program to assess the adequacy of the Semiscale Mod-3 test system design. Results of the first two nuclear loss-of-coolant experiments performed in the Loss-of-Fluid Test (LOFT) Facility were evaluated; the evaluation indicates that the intent of licensing criteria is valid. Completion of two nuclear blowdown (depressurization) tests in the Power Burst Facility (PBF) is reported by the Thermal Fuels Behavior Program; results of one test are discussed. Analysis of the accident that occurred in the Three Mile Island Unit 2 (TMI-2) nuclear power plant was performed by the Code Development and Analysis Program using computer simulations, with good agreement between TMI-2 accident data and calculations. Audit calculations were performed to support NRC review of reactor vendor safety analyses by the Code Assessment and Applications Program.

8556 (NUREG/CR—1121) **Quarterly progress report on Blowdown Heat Transfer Separate-Effects Program for July-September 1979.** White, J.D.; Anklam, T.M.; Bohanan, R.E.; Craddick, W.G.; Felde, D.K.; Flanders, R.M.; Hagar, R.C.; Ott, L.J.; Smith, A.N. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 19p. (ORNL/NUREG/TM—363). Dep. NTIS, PC A02/MF A01.

Bundle 3 was installed into the Thermal-Hydraulic Test Facility (THTF) test section on June 26, 1979. This bundle is an 8 x 8 array of electric fuel pin simulators 9.5 mm in diameter. Each of the fuel pin simulators has a flat power profile 3.6 m long. The rod-to-rod pitch is representative of a 17 x 17 pressurized-water reactor subassembly. Each fuel pin simulator has 16 thermocouples in groups of four (one centered and three azimuthal) at each of four levels. The THTF was modified to have a separate external downcomer which includes two new instrumented spool pieces. The current status of the THTF is called THTF-Mod II. Operational testing of the system will be completed with the first isothermal blowdown in November 1979.

8557 (NUREG/CR—1160) **LMFBR safety. 7. Review of current issues and bibliography of literature (1978).** Buchanan, J.R.; Keilholtz, G.W. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 85p. (ORNL/NUREG/NSIC—166; ORNL/NUREG/NSIC—125(Vol.7)). Dep. NTIS, PC A05/MF A01.

This report discusses the current status of liquid-metal fast breeder reactor (LMFBR) development. Selected bibliographic information on LMFBRs relative to the development and safety of the breeder reactor is presented for the year 1978. The bibliography consists of approximately 127 abstracts covering research and development, operating experience, and design practices. Keyword, author, and permuted-title indexes are included for completeness.

8558 (NUREG/CR—1164) **Light-water-reactor safety research program. Quarterly progress report, April-June 1979.** (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 41p. (ANL—79-81). Dep. NTIS, PC A03/MF A01.

This progress report summarizes the Argonne National Laboratory work performed during April, May, and June 1979 on water-reactor-safety problems. The following research and development areas are covered: (1) loss-of-coolant accident research: heat transfer and fluid dynamics; (2) transient fuel response and fission-product release program; and (3) mechanical properties of Zircaloy containing oxygen.

8559 **Analytic prediction of thermal profile development and inversion for use in in-pile experimentation.** Weber, D.P. (Argonne National Lab., IL). *Nucl. Technol.;* **45**: No. 3, 203-218(Oct 1979).

The assessment of the consequences of hypothetical accidents in liquid-metal-cooled fast reactors often requires interaction between analysis and in-pile experiments, where experiments must provide geometry, boundary conditions, and thermal profiles that are prototypical of the accident scenario. Neutronic heating of test samples initially produces atypical thermal profiles, and a time period is required to elapse for thermal inversion. An analytic transient heat conduction analysis using multiregion eigenfunctions is provided to determine the space-time temperature profiles. With an assumed weak temporal dependence for eigenfunctions greater than the first, a determination of the motion of the position of maximum temperature is made, leading to a simple expression for the time to thermally invert completely, which requires knowledge of only the first eigenvalue and the expansion coefficient of the source for the fundamental mode, with similar analysis providing an estimate of the time to reach melting. A functional relationship is established between the operating reactor power, the thermal properties of the materials, and the boundary conditions to ensure satisfaction of both criteria of rapid thermal inversion and maximum temperatures above prescribed levels, such as melting. The analysis is then applied to a proposed in-pile experiment for studying pool boilup in internally heated fuel-steel pools with nuclear heated walls. It is shown that for a variety of external boundary conditions, a reactor power level may be chosen to ensure integrity of the insulating wall while simulating the pool boilup phenomena without the necessity of enrichment grading to enhance thermal inversion.

8560 **TREAT test H6-A 50 cents transient overpower accident simulation.** Page, R.J.; Fink, C.L.; Rothman, A.B.; Lo, R.K.; Robinson, L.E.; Froehle, P.H. (Argonne National Lab., IL). *Nucl. Technol.;* **45**: No. 3, 249-268(Oct 1979).

Transient Reactor Test Facility (TREAT) Test H6 was run to simulate a transient overpower (TOP) initiated 50 cent/s hypothetical core disruptive accident (CDA). The primary purpose was to investigate the extent to which molten fuel could be removed from the active core region following fuel pin failure, and the extent to which this would be accomplished while maintaining coolant flow. Coolant flow rates and pressures typical of those in the Fast Flux Test Facility were used. The test fuel sample consisted of a bundle of seven mixed-oxide fuel pins which had been preirradiated in the Experimental Breeder Reactor II to ~ 6 at % burnup. The liquid sodium coolant had an initial velocity of 6.20 m/s at a temperature of 742 K. A programmed TREAT power ramp with a period of 1.65 s was used to bring the experimental fuel sample to failure conditions. The test data showed that there were three main events associated with fuel pin failure. During the first of these events, fuel was removed from the active fuel region and relocated ~ 40 cm downstream. The coolant flow rate recovered to ~ 93% of its preevent value. Additional fuel was removed from the active fuel region during the second event and again relocated some 40 cm downstream. However, molten fuel also began to accumulate in a region centered on the centerline of the original fuel column. The coolant flow rate recovered to ~ 75% of its initial value. The third event was considerably more violent than the others and while a considerable quantity of fuel was relocated well downstream of the active fuel column, a blockage was formed at the top of the fuel column which reduced the coolant flow to zero. Analysis of the flowmeter signals indicated that the fuel pin holder failed during the third event. This could be at least partially responsible for the coolant channel blockage following this event.

ENERGY STORAGE

REFER ALSO TO CITATION(S) 8817

8561 (CONF-790854—) **Proceedings of the 1979 mechanical and magnetic energy storage contractors' review meeting.** (Department of Energy, Washington, DC (USA). Div. of Energy Storage Systems). Dec 1979. 526p. Dep. NTIS, PC A23/MF A01.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

Separate abstracts have been prepared for individual papers. Each paper is preceded by a project summary sheet describing the project goals, project status, and other pertinent information. (TFD)

8562 (LA-UR—79-3098) **Energy storage technology-environmental implications of large scale utilization.** Krupka, M.C.; Moore, J.E.; Keller, W.E.; Baca, G.A.; Brasier, R.I.; Bennett, W.S. (Los Alamos Scientific Lab., NM (USA); Los Alamos Technical Associates, Inc., NM (USA)). 1979. Contract W-7405-ENG-36. 20p. (CONF-791204—4). Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

Environmental impacts for several energy storage technologies have been identified. State-of-the-art control technology options were similarly identified. Recommendations for research and development on new control technology were made where present controls were either deemed inadequate or non-existent. Specifically, the energy storage technologies under study included: advanced lead-acid battery, compressed air, underground pumped hydroelectric, flywheel, superconducting magnet and various thermal systems (sensible, latent heat and reversible chemical reaction). In addition, a preliminary study was conducted on fuel cell technology. Although not strictly classified as an energy storage system, fuel cells in conjunction with product recycling units can serve an energy storage function. A very large number of potential environmental impacts can be identified for all of these technologies. However, not all are of primary importance. Detailed discussions of a number of environmental impacts from the latest LASL study as they relate to primarily operational situations are emphasized. In addition, a brief discussion on new application for energy storage technologies and the additional costs of controls to be used for mitigation of specific impacts are also presented.

MAGNETIC

8563 (CONF-790854—, pp 4-8) **Standards for superconductors.** Fickett, F.R.; Clark, A.F. (National Bureau of Standards, Boulder, CO). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The report describes the present state of the superconductor standards program and includes a brief historical introduction. The need for standards in this area is described with particular attention paid to the need for consensus among all interested parties and our techniques for achieving it. Early results from the experimental research projects are presented and the scope of the entire program is outlined.

8564 (CONF-790854—, pp 10-19) **Stabilization unit for Bonneville Power Administration.** Schermer, R.I. (Los Alamos Scientific Lab., NM). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The Bonneville Power Administration operates the transmission system that joins the Pacific Northwest and southern California. A 30-MJ (8.4 kWh) Superconducting Magnet Energy Storage (SMES) unit with a 10-MW converter can provide system damping for low frequency oscillations. The unit is scheduled to operate in 1982. Progress during FY 79 is described, including the details of mechanical and electrical testing of prototype conductors and the design, specification, and procurement activities for the energy storage coil, nonconducting dewar, electrical system, and cryogenic system.

8565 (CONF-790854—, pp 22-25) **Designing the magnet for the Bonneville Power Administration.** Purcell, J.R. (General Atomic Co., San Diego, CA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The paper describes the design of the Bonneville 30 MJ superconducting stabilizing coil. The various components in the coil are described along with the rationale for materials choice. The 30 MJ coil is a solenoid with a winding bore of 107 inches. It will be 48 inches tall and have an outside diameter of 134 inches. Peak field on the conductor will be about 2.7 T at full current of 4900 amperes and the stored energy will be 32 MJ. Total weight of the finished coil will be 36,000 pounds.

8566 (CONF-790854—, pp 28-46) **1-Gwh diurnal load-leveling superconducting magnetic energy storage system reference design.** Rogers, J.D. (Los Alamos Scientific Lab., NM). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

A point reference design has been completed for a 1-GWh Superconducting Magnetic Energy Storage system. The system is

for electric utility diurnal load-leveling; however, such a device will function to meet much faster power demands including dynamic stabilization. The study has explored several concepts of design not previously considered in the same detail. Because the study is for a point design, optimization in all respects is not complete. The study examines aspects of the coil design; superconductor supported off of the dewar shell; the dewar shell, its configuration and stresses; the underground excavation and related construction for holding the superconducting coil and its dewar; the helium refrigeration system; the electrical converter system; the vacuum system; the guard coil; and the costs. The report is a condensation of the more comprehensive study which is in the process of being printed.

8567 (CONF-790854—, pp 48-57) **Component development for large magnetic storage units.** Van Sciver, S.W.; Boom, R.W. (Univ. of Wisconsin, Madison). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

A survey of University of Wisconsin research and development on components for large scale superconductive energy storage units is presented. The major activities involve development of the aluminum stabilized-NbTi composite conductor and the fiberglass reinforced polyester strut. Scale models of these components have been produced and tested. Design activities have been directed toward consideration of a 15 tunnel design to reduce axial structure. Rock mechanics studies of the 15 tunnel design are also reported.

8568 (CONF-790854—, pp 60-66) **Electrical engineering considerations for diurnal superconductive storage devices.** Skiles, J.J. (Univ. of Wisconsin, Madison); Prince, J.B. Jr. Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The report describes electrical studies at the University of Wisconsin associated with the design and operation of superconductive magnetic energy storage (SMES) systems utilized for electric utility load leveling. The power delivery capability of the phase controlled thyristor inductor-converter (I-C) bridge and the necessity for minimizing or compensating for the reactive power drawn from the power system by the I-C unit are identified as major power system considerations. A System Planning Analysis for Evaluating SMES is suggested.

8569 (CONF-790854—, pp 68-79) **Evaluation of superconducting magnetic energy storage.** Winer, B.M. (Arthur D. Little, Inc., Cambridge, MA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The object of this investigation into the benefits and likely costs of Superconducting Magnetic Energy Storage (SMES) Systems was to determine if continued R & D support by DOE is justified. The results of the study indicate that due to the high efficiency with which the SMES System could accept and regenerate ac electrical energy, an SMES unit can compete economically with alternative advanced storage technologies if its capital costs and the efficiencies are within the estimated range, and the unit is sized so as to allow it to perform the same task proposed for alternative generator types and no more. However, the present SMES System design is unlikely to be able to meet the electric utilities' requirements of reliability, maintainability and system protection; and the costs of a unit which could meet these requirements are unknown. In addition, there is considerable uncertainty about the design and cost of major subsystems and the environmental impact of the magnetic field. Thus, while continued support of R & D programs for the SMES system may appear to be justified, the goal of this work should be providing information to allow a final assessment of the ability of SMES to help meet the nation's future energy needs.

8570 (CONF-790854—, pp 82-89) **Force balanced magnetic energy storage system.** Mawardi, O.K.; Nara, H.; Grabnic, M. (Case Western Reserve Univ., Cleveland, OH). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

A novel scheme of constructing coils suited for inductive storage system is described. By means of a force-compensating method, the reinforcement structure can be made considerably smaller than that needed for conventional coils. The economics of this system is shown to be capable of achieving savings of upwards of 40% when compared to a conventional system.

8571 (CONF-790854—, pp 92-96) **Energy storage in superconductive magnets: a demonstration.** Rosner, C.H. (Intermagnetics General Corp., Guilderland, NY). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The possible utilization of superconductive magnets as efficient energy storage systems has been proposed and explored a number of times during the past 15 years. In order to clearly demonstrate the salient features of such a system, an operational model was constructed. Using a superconductive magnet having a stored energy capability of 20,000 joules, the system includes a cryostat as well as charging and discharge equipment. The energy can be discharged in a 50 W light bulb, a spark-gap, a tape-recorder, or any appliance that can operate at 12 or 110 volts.

8572 (CONF-790854—, pp 140-147) **Two-dimensional fluid and thermal analysis of dry porous rock reservoirs for CAES.** Wiles, L.E. (Battelle Pacific Northwest Lab., Richland, WA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The analysis of the hydrodynamic and thermodynamic response of a Compressed Air Energy Storage (CAES) dry porous media reservoir subjected to daily air mass cycling is described. The analysis is based upon a numerical computer model that uses a finite difference method to solve the two-dimensional (r-z) conservation equations for the transport of mass, momentum, and energy in the below ground system. The investigation quantifies the behavior of those parameters that enter the model by virtue of inclusion of the vertical dimension. The topics that were evaluated were the wellbore heat transfer and the pressure and temperature response of the reservoir. The wellbore heat transfer was evaluated with respect to insulation, preheating (bubble development with heated air), and air mass flow rate. The wellbore heat transfer reduces thermal energy recovery while offering the advantage that the temperatures and thermal cycling at the reservoir were reduced. The most severe thermal cycling occurred in the wellbore near the earth surface. The pressure and temperature responses of the reservoir were found to be largely dependent on the producing length of the wellbore within the porous zone. Reduced producing lengths resulted in increased reservoir pressure losses as well as nonuniform temperature distributions. Other reservoir parameters that were evaluated that had less significant effects were anisotropic permeability and stratified permeability, heat losses to the vertical boundaries, and natural circulation.

COMPRESSED GAS

REFER ALSO TO CITATION(S) 8593

8573 (CAES—7) **Application and design studies of compressed-air energy storage for solar applications. Final report.** Flynn, G.T.; Nash-Webber, J.L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 28 Sep 1979. Contract EX-76-A-01-2295-029. 118p. Dep. NTIS, PC A06/MF A01.

This report describes a study of adiabatic Compressed-Air Energy Storage (CAES), in which both the heat of compression and the compressed air are stored separately, and the applicability of this technology to solar power systems. The basic thermodynamics of ideal single- and two-stage adiabatic CAES is reviewed. Generic single-stage and two-stage types are discussed, and efficiency and mass flow rate as a function of storage pressure and stage pressure ratios are investigated. The performance and cost of available turbomachinery for the single- and two-stage adiabatic systems are given in detail as the basis for evaluating sixteen candidate near-term single-stage and two-stage designs. Both excavated caverns and abandoned mines are considered for storage reservoirs. Two scenarios are considered regarding joint application of CAES and Solar Thermal Energy (STE) systems. One is based on providing local CAES storage for STE systems, other on providing solar-augmentation to adiabatic CAES installations. Both solar-heated thermal storage and fuel firing are considered for provision of necessary backup during bad weather. Solar-heated heat-topping of adiabatic CAES is also considered, but rejected as an unattractive technology. The economics of all these systems is ranked on the basis of delivered busbar energy cost for three different charging energy costs. The adiabatic systems are compared to fired systems to determine the breakeven cost of fuel which yields the same busbar energy cost. An economic comparison with pumped hydro and peaking gas turbines is also given. Recommendations for future development of this technology are presented.

8574 (CONF-790854—, pp 100-104) **Compressed Air Energy Storage Program overview.** Loscutoff, W.V. (Battelle Pacific Northwest Lab., Richland, WA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The DOE Compressed Air Energy Storage (CAES) Technology Program consists of a group of interrelated studies directed at developing a new technology to improve the cost and efficiency of electrical power utilization and reducing the consumption of petroleum fuels. The program has two major elements - Reservoir Stability Studies and Advanced Concepts Studies. The Reservoir Stability Studies are aimed at developing long-term design and stability criteria for underground reservoirs used in CAES plants. The Advanced Concepts Studies are directed at development of CAES configurations that will require little or no petroleum fuels for firing of the turbines. The paper summarizes the program efforts during

FY-1979, outlines specific tasks, indicates current progress, identifies future activities, and points out milestones and accomplishments.

8575 (CONF-790854—, pp 106-117) **Numerical studies of compensated CAES caverns in hard rock.** Gnirk, P.F.; Brandshaug, T.; Callahan, G.D.; Ratigan, J.L. (RE/SPEC Inc., Rapid City, SD). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The paper presents some results of thermal, mechanical, and air leakage modeling analyses for compensated CAES caverns in hard rock. Particular attention is drawn to the influence on the in situ (pre-mining) stress state on pre-operational cavern stability and operational air leakage. Consideration is also given to the region of cyclic temperature perturbation around an operational CAES cavern and the time required to achieve a quasi-steady temperature field in the rock mass. Where possible, the implications of the modeling results are qualitatively confirmed by comparison with case history data and observations.

8576 (CONF-790854—, pp 120-127) **Laboratory testing of hard rock specimens for compensated CAES caverns.** Fossum, A.F. (RE/SPEC Inc., Rapid City, SD). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

Laboratory scale testing and its role in the formulation of compressed air energy storage (CAES) cavern stability and design criteria are discussed with viewpoints toward fundamental and special tests. Fundamental testing provides numerical values of parameters between stress and strain. In addition to the initial elastic constants, six fundamental coefficient material functions are identified of which five require data fitting. The constitutive equations deemed appropriate are inelastic but incrementally linear and involve a combination of incremental plasticity and fracturing material theory. Special testing provides answers to specific questions related to rock behavior in the presence of CAES operating conditions. For example, "How is the load bearing capacity and stiffness of rock affected by thermomechanical cycling in the presence of moisture under pressure." These and other similar questions must be answered by testing rock in systems which reproduce the operating conditions as closely as possible.

8577 (CONF-790854—, pp 130-137) **Permeability and friability alterations in quartzose sandstones exposed to elevated temperature humidified air.** Stottlemyre, J.A.; Erikson, R.L.; Smith, R.P. (Battelle Pacific Northwest Lab., Richland, WA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The feasibility of elevated temperature Compressed Air Energy Storage concepts may depend, to a major extent, upon the physical and chemical stability of reservoir rocks to new environmental conditions. The paper is based on preliminary autoclave studies of quartzose sandstones exposed to simulated CAES subsurface conditions. The properties of primary concern are absolute gas permeability, friability, and compressibility. Independent variables include temperature (50 to 300°C), pressure (20 to 120 bars), experiment duration (14 to 56 days), and environment (dry air, humidified air, or brine). Preliminary observations, based on a very limited data set, are: (1) quartzose sandstones exposed to dry air exhibit excellent property stability under all test conditions; (2) samples undergo significant disaggregation when exposed to brine at temperatures as low as 100 to 150°C; and (3) when exposed to humidified air at elevated temperature. Preliminary results indicate sandstones may be suitable storage media for heated, humid air as long as elevated temperature zones are relatively free of mobile liquid phase water.

8578 (CONF-790854—, pp 150-155) **Thermo-mechanical properties of Galesville sandstone.** Blacic, J.D.; Halleck, P.H.; D'Onfro, P. (Los Alamos Scientific Lab., NM). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

Elastic and strength properties of Galesville sandstone are temperature and pressure dependent over the range appropriate for an aquifer compressed air energy storage system. At 37°C, Young's modulus increases from 23 GPa at ambient pressure to 47 GPa at 31 MPa effective pressure while Poisson's ratio decreases from 0.30 to 0.22. At 120°C Young's modulus increases from 28 GPa at ambient pressure, to 60 GPa at 33 MPa effective pressure while Poisson's ratio decreases from 0.22 to 0.08. Under ambient conditions, tensile strength is 4 MPa. At 37°C, ultimate compressive strength increases from 70 MPa at ambient pressure to 200 MPa at 32 MPa effective pressure. At 120°C, strength increases from 56 MPa at ambient pressure to 262 MPa at 30 MPa effective pressure. Cyclic loads of 20 MPa at 37°C and 10.4 MPa effective pressure indicate no effect on Young's modulus and ultimate strength up to 10,000 cycles; Poisson's ratio is reduced 28%.

8579 (CONF-790854—, pp 158-165) **Structural response of a generic porous site.** Friley, J.R. (Battelle Pacific Northwest Lab., Richland, WA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

Structural response of a hypothetical compressed air energy storage (CAES) porous rock site was investigated. Emphasis was placed on gross response of the porous rock site rather than detailed behavior in the wellbore vicinity. Structural loading conditions considered nonuniform thermal loading, pore pressure loading, in situ and overburden effects. Loading conditions corresponding to several stages of site development and operation were investigated. Both mean and cyclic structural response of the reservoir were investigated by utilizing thermal and pore pressure loadings corresponding to various times of a one year thermal/flow simulation. Attention was focused on several areas of site structural behavior. These included tensile stress levels in the site caprock, fatigue stress levels in the cap and porous rock masses, and margin of safety values for the porous rock based upon a Mohr-Coulomb failure envelope for Galesville sandstone. Results from these investigations indicate that zones of significant structural response are concentrated in the wellbore vicinity. This is especially true of the caprock mass and is attributed largely to the assumption of casing insulation made in the thermal/flow simulation.

8580 (CONF-790854—, pp 169-173) **Laboratory studies of salt response to CAES conditions.** Thoms, R.L. (Louisiana State Univ., Baton Rouge). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

A testing program is described for establishing a data base on rock salt response and for formulating long-term stability criteria for cyclic loadings typical of operational compressed air energy storage (CAES) caverns. The program is divided in two generalized laboratory phases, i.e., (1) cyclic temperature and triaxial stress tests at LSU, and (2) in-situ cyclic temperature and pressure tests in boreholes in salt mines. Accomplishments to date and work still to be done are reported and summarized.

8581 (CONF-790854—, pp 176-181) **Complementary and potential CAES field studies.** Doherty, T.J. (Battelle Pacific Northwest Lab., Richland, WA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

Field studies at PNL form an integral part of the transition from concept examination and applied research to development and demonstration of CAES technology. Small scale directed studies for three media types are presently in a conceptual phase. Porous media work is directed towards determining in situ permeability changes and wellbore desaturation. A shallow aquifer high temperature injection test is in planning. The key concern in salt is the effect of air penetration and temperature at high strain, low confining stress conditions. Bench scale or small in-situ cavern experiments are being examined for feasibility and cost. An in situ study of hard rock reservoir parameters is awaiting detailed prioritization of key areas of concern.

8582 (CONF-790854—, pp 184-190) **Advanced concepts studies.** Allemann, R.T.; Drost, M.K. (Battelle Pacific Northwest Lab., Richland, WA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The objectives of this program are to reduce or eliminate the dependence of CAES systems on petroleum fuels. The approach has been to evaluate improved cycles, equipment capabilities, coal firing methods, and thermal energy storage as applied to CAES. The evaluations have included both technical and economic studies. Preliminary results show technical promise for CAES systems integrated with coal fired fluid bed combustion, with thermal energy storage, and coal burning steam plants. The latter system uses advanced indirect thermal energy storage that shows economic benefits over direct thermal energy storage. A review of coal gasification shows potential benefits when coupled with a CAES peaking plant.

8583 (CONF-790854—, pp 192-198) **Economics of thermal energy storage for compressed air energy storage systems.** Schulte, S.C. (Battelle Pacific Northwest Lab., Richland, WA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The costs of compressed air energy storage (CAES) systems utilizing thermal energy storage are compared with the costs of conventional CAES systems and combustion gas turbine systems. Comparisons are made on the basis of system energy cost levelized over system operating lifetime (mills/kWh). The comparison was performed by Pacific Northwest Laboratory for the Department of Energy using information from reference studies by the Massachusetts Institute of Technology, Central Electricity Generating Board and Knutsen Research Services. System energy costs were estimated

using information from three reference CAES/thermal energy storage studies, a recent PNL research effort, and the EPRI Technical Assessment Guide. Capital investment cost estimates and system operating requirements were obtained from the reference studies. Current turbine fuel and compression energy prices were obtained from a July 1979 PNL research effort. Economic and financial input assumptions and a discounted cash flow-required revenue computational methodology were taken from the Technical Assessment Guide. Use of such a normalization procedure results in system energy cost estimates that are both realistic and comparable. Two principal conclusions resulted from the study. First, given today's fuel prices and the expected fuel prices in the 1980's, conventional CAES systems yield lower energy cost estimates than combustion gas turbine systems. Second, thermal energy storage/adiabatic CAES systems yield equivalent and, in some instances, slightly lower energy cost estimates than conventional CAES systems while requiring considerably less turbine fuel oil.

8584 (CONF-790854—, pp 200-214) **Preliminary evaluation of coal-fired fluid bed combustion-augmented compressed air energy storage power plants.** Giramonti, A.J. (United Technologies Research Center, East Hartford, CT). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The paper presents the highlights of an ongoing program to assess the technical and economic feasibility of advanced concepts for generating peak-load electric power from a compressed air energy storage (CAES) power plant incorporating a coal-fired fluid bed combustor (FBC). Specifically, it reviews: the design and operating considerations involved with integrating an atmospheric fluid bed combustor (AFBC) or a pressurized fluid bed combustor (PFBC) with a CAES system to yield practical system configurations; the integration of system configurations; the parametric performance of these system configurations; and the preliminary screening which considered performance, cost, and technical risk and which led to the identification of an open-bed PFBC/CAES system as having the greatest near-term commercialization potential.

8585 (CONF-790854—, pp 304-308) **Industrial compressed air applications for solar energy conversion/storage devices.** McEwen, L.B.; Swain, J.W. (Jalar Associates, San Francisco, CA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The purpose of this contract effort was to determine the feasibility of utilizing solar energy devices and compressed air energy storage to supply power for industrial compressed air systems. The fulfillment of this effort entailed the performance of three separate tasks. The first task established a profile of installed industrial compressed air capacity, the amount of plant air normally used, and the energy required to produce this air. This results provided a perspective for the potential energy savings that might accrue from subsequent work. The second task evaluated the technical feasibility of using energy from solar sources to power industrial compressed air systems either directly or through the employment of energy conversion or storage devices. Should such an arrangement be technically feasible, then the purpose of task three was to determine the economic viability of specific and representative approaches. The principal findings of this study are presented. (WHK)

8586 (CONF-790998—1) **Computer aided optimal design of compressed air energy storage systems.** Ahrens, F.W.; Sharma, A.; Ragsdell, K.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 44p. Dep. NTIS, PC A0?/MF A01.

From Design automation conference; St. Louis, MO, USA (12 Sep 1979).

An automated procedure for the design of compressed Air Energy Storage (CAES) systems is presented. The procedure relies upon modern nonlinear programming algorithms, decomposition theory and numerical models of the various system components. Two modern optimization methods are employed; BIAS, a Method of Multipliers code and OPT, a Generalized Reduced Gradient code. The procedure is demonstrated by the design of a CAES facility employing the Media, Illinois Galesville aquifer as th reservoir. The methods employed produced significant reduction in capital and operating cost, and in number of aquifer wells required.

8587 (CONF-791069—3) **Optimal design of compressed air energy storage systems.** Ahrens, F.W.; Sharma, A.; Ragsdell, K.M. (Argonne National Lab., IL (USA); Illinois Univ., Chicago (USA); Purdue Univ., Lafayette, IN (USA)). 1979. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

From 6. annual conference on energy; Rolla, MO, USA (16 Oct 1979).

Compressed air energy storage (CAES) power systems are currently being considered by various electric utilities for load-leveling applications. Models of CAES systems which employ natural underground aquifer formations, and present an optimal design methodology which demonstrates their economic viability are developed. This approach is based upon a decomposition of the CAES plant and utility grid system into three partially-decoupled subsystems. Numerical results are given for a plant employing the Media, Illinois Galesville aquifer formation.

8588 (EPRI-EM—1188) **Parametric performance evaluation and technical assessment of adiabatic compressed air energy storage systems. Final report.** Lessard, R.D.; Blecher, W.A. (United Technologies Research Center, East Hartford, CT (USA)). Oct 1979. 157p. Dep. NTIS, PC A08/MF A01.

An adiabatic compressed air energy storage (ACAES) system is an advanced compressed air energy storage (CAES) system concept that features thermal energy storage (TES). The study confirmed the CEGB findings that the intermediate-pressure hybrid ACAES system (an ACAES system wherein the heat of compression is transferred to the TES at a pressure level substantially below the cavern air storage pressure and which utilizes combustion of some fossil fuel prior to expansion to raise the turbine inlet temperature) has the greatest potential for near-term commercialization of all presently identified ACAES configurations. The study also indicated that the level of performance and the level of turbomachinery technology required of an intermediate-pressure hybrid ACAES system are comparable to those levels characteristic of conventional CAES systems. In addition, it suggested that the high-pressure ratio, uncooled compressor required for a high-pressure ACAES system (an ACAES system wherein the air is compressed without cooling to essentially air storage pressure prior to heat rejection in the TES) could be feasible, but additional detailed design and cost estimates will be required before feasibility can be judged.

PUMPED HYDRO

REFER ALSO TO CITATION(S) 8593

8589 (CONF-790854—, pp 218-228) **Comparison of single, double, and multistage pump/turbine equipment for underground pumped storage service.** Degnan, J. (Allis-Chalmers Corp., York, PA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The paper attempts to summarize the significant design considerations found during the development of single, double, and multistage reversible hydro machinery for the Underground Pumped Hydro Storage project (UPHS) currently funded through the US Department of Energy (DOE). This year's study involves the following major objectives: (1) complement the 500 MW Pump/Turbine equipment developed last year for UPHS with 350 MW machinery; (2) in addition, develop efficient multistage pump/turbine designs for the operating conditions used in the designing of all the Allis-Chalmers single and double stage machinery for UPHS so far; and (3) establish parametric relations for the cost of reversible hydro machinery as a function of head, capacity, and number of stages. Examples of the preliminary designs for the different staged machines are included. Special design considerations and conclusions as to the feasibility and limitations of each type of machine are drawn according to their expected cost, mechanical and hydraulic considerations.

8590 (CONF-790854—, pp 230-246) **Turbomachinery considerations for underground pumped hydroelectric storage plants (UPHS).** Tam, S.W.; Frigo, A.A.; Blomquist, C.A. (Argonne National Lab., IL). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

UPHS plant costs for plants equipped with advanced reversible pumped turbines have been considered. Equipment used includes single- and two-stage reversible pump turbines for operating heads from 500 to 1500 m. The effects of machinery costs, operating heads, plant configurations, and sizes have been taken into account. The results indicate that the use of advanced machinery seems to push the minimum UPHS plant cost to heads greater than 1500 m. The employment of advanced reversible pump turbines seems to be economically attractive. It is shown that pump-turbine efficiencies and the so-called charge/discharge ratio are very important design parameters for UPHS applications and the interactive effects of these parameters have been analyzed. The results show that under certain conditions a pump-turbine option with a higher charge/discharge ratio at the expense of somewhat lower operating efficiency can be desirable.

8591 (CONF-790854—, pp 248-261) **Assessment of the application potential of the pumps with controlled flow rate for energy storage.** Gokhman, A.; Ozboya, N. (EDS Nuclear Inc., San Francisco, CA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The present project covers the comparison of the turbine-pumps and pumps with controlled flow rate with the alternative

equipment for the different areas of application. The analyses showed the definite advantage of these new machines for the main areas of application.

8592 (CONF-790854—, pp 296-302) **Feasibility study of a small pumped aquifer storage system for solar and wind energy.** Mansure, A.J. (BDM Corp., Albuquerque, NM). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The technical and economic feasibility of storing surplus solar and wind energy in rural locations is being investigated for a small hydro/mechanical system that pumps water from a subsurface aquifer to a surface reservoir and then recovers the energy by allowing the water to return to the aquifer. An analysis of rural user energy demands, institutional and legal issues, and aquifer characterization has been completed. The availability of equipment to operate the system has been investigated and it has been determined, with the exception of specialized control equipment, that off-the-shelf equipment exists that meets rural installation and maintenance needs. A system design that integrates the components, based on energy availability and user demand, is in progress. Economic analysis will follow completion of the engineering study.

FLYWHEELS

REFER ALSO TO CITATION(S) 8339, 8828, 8829

8593 (CONF-790854—, pp 266-271) **Solar Mechanical Energy Storage Program: overview and systems analysis results.** Caskey, B.C. (Sandia Labs., Albuquerque, NM). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The current status of the Solar Mechanical Energy Storage Program is described, along with the remaining activities before Lawrence Livermore Laboratory assumes program responsibility in October 1979. Contractor results are presented in other papers; preliminary system analyses results for residential flywheel energy storage systems (FESS) are presented. Various phases of the program have addressed small-to-intermediate applications of photovoltaic/wind energy storage utilizing flywheels, compressed air and low head underground pumped hydro technologies.

8594 (CONF-790854—, pp 274-286) **Flywheel energy storage system concept for a residential photovoltaic supply.** Younger, F.C. (William M. Brobeck & Associates, Berkeley, CA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

A conceptual design of a flywheel energy storage system suitable for on-site interfacing with small scale solar energy sources has been developed. The basic design objective was to provide a generous margin of safety and above average reliability and efficiency at the lowest practical cost. This paper describes the basic design concept and the general approach to the conceptual design of the energy storage system. The basic concept to interface with solar energy sources utilizes a constant voltage motor/generator directly coupled to a flywheel rotor. The voltage level of the motor is maintained at the optimum operating voltage of the array of photovoltaic cells and permits peak power tracking. Power is drawn from the flywheel-driven generator when the voltage output of the array drops below its optimum value and power is delivered to the flywheel via the generator (then operating as a motor) when the voltage rises above the optimum value. A variety of motor types and flywheel rotor types has been studied to arrive at a conceptual design to meet the program objectives. A fiber-composite rotor driving a separately-excited motor satisfies the basic requirements. To obtain acceptable efficiency and low rundown losses, the flywheel operates in a vacuum and has a combination of magnetic thrust support and ball bearings to reduce bearing friction in an economical fashion. The need for rotary vacuum seal is eliminated by the use of a hermetically-sealed magnetic power coupling.

8595 (CONF-790854—, pp 288-293) **Residential flywheel with wind turbine supply.** Place, T.W. (AiResearch Manufacturing Co. of California, Torrance). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

A flywheel system that stores energy from a wind turbine source and converts the energy to a 60-Hz, 220-V output for residential use is described. The typical residence has a 1500-sq ft floor area, with a maximum power level of 5 kW. The flywheel system was defined in a study to determine the cost benefits of storing wind energy in a flywheel and using it on a demand basis. The systems and the flywheel rotor materials that offer the greatest promise in reducing initial costs were examined. The progress to date on this program and the work planned to complete the study are described.

8596 (CONF-790854—, pp 310-317) **Overview of contracts with colleges and universities for advanced flywheel concepts.** Schildknecht, H.E. (Sandia Labs., Albuquerque, NM). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The Solar Mechanical Energy Storage Project work performed under the direction of Sandia Laboratories includes contracts with one college and two universities for studies on advanced flywheel concepts. The three institutions involved and their respective advanced-concept pursuits are as follows: University of Minnesota, cellulosic flywheels; Union College, variable inertia flywheel; and Texas A & M University, flexible flywheel. The primary objectives of the contract with the University of Minnesota are to evaluate the physical properties of cellulosic materials (primarily plywood) relative to suitability for flywheels, and to develop inexpensive methods of metallic-hub attachment and dynamic balancing for cellulosic flywheels. Of particular interest is the effect of prolonged vacuum exposure on plywood strength and durability. The contract with Union College is to characterize the dynamics of their proposed band-type variable inertia flywheel and determine if it offers potential advantages in the areas of economy, reliability and efficiency. The Texas A & M contract is primarily directed at studying the rotational characteristics of a flywheel configuration featuring flexible spokes and rim, with particular emphasis being placed on devising practical methods for suppressing undesirable whirl modes. All three of the above contracts are scheduled to be completed by September 1979.

8597 (CONF-790854—, pp 332-338) **Sandia activities overview.** Woods, R.O. (Sandia Labs., Albuquerque, NM). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The report presents all Sandia efforts in the field of components development during FY79. Particular emphasis is placed upon activities not reported at the October 1978 review meeting. A complete list of the publications that were generated during the reporting period is included and will be presented as a handout during the verbal presentation.

8598 (CONF-790854—, pp 340-346) **Rotor dynamics: dynamics of rim-type flywheels supported by flexible bands.** Bert, C.W. (Univ. of Oklahoma, Norman). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

Certain high-performance, composite-material flywheel systems for energy storage on vehicles differ significantly from turbine/compressor systems in two respects: the flywheel rim attachment to its hub is very flexible (especially in tilting) and these flexibilities depend upon rotational speed through centrifugal stiffening. The paper describes analysis of free whirling, suggestions for design improvements, stability analysis, response to unbalance and initial tilt, and nonlinear analysis of supporting-band action.

8599 (CONF-790854—, pp 348-355) **Recent spin tests of two composite wagon wheel flywheels.** Miller, A.K. (Sandia Labs., Albuquerque, NM). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The paper briefly discusses some observations made of spin tests performed on two variations of the Sandia wagon wheel flywheel. In one design, the graphite/epoxy rim was attached to the aluminum hub with twenty-four thin Kevlar-49/epoxy spokes, while in the other design eight thicker graphite/epoxy spokes connected the rim to the hub. The test objective was to compare the dynamic behavior of the two structurally dissimilar flywheels. The tests were limited to speeds less than 22,000 rpm and only moderate torques were applied during the acceleration phase of the tests in an attempt to detect speeds for previously predicted modes of vibration of the flywheel-spin-turbine system. Using proximity sensors, horizontal disturbances of the flywheel hub were detected for speeds less than approximately 6,000 rpm. These disturbances are believed to be associated with predicted modes of vibration for the flywheel-spin-turbine system. No modes of vibration were sensed for the predicted possible whirl and torsional resonances in the speed range between 6,000 rpm and 22,000 rpm. A squeeze film damper assembly which was attached to the flywheel spindle shaft is believed to have sufficiently dampened possible whirl modes so that they were undetectable in the speed range tested. The tests indicated that the squeeze film damper assembly successfully stabilized the flywheel-spin-turbine system when the damper functioned properly; however, low frequency retrograde instabilities were induced into the system by the damper assembly when it was not operated within prescribed parameters.

8600 (CONF-790854—, pp 358-361) **Experimentally determined modes of three composite flywheels.** Nord, A.R. (Sandia Labs., Albuquerque, NM). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

Three composite flywheels were analyzed by the Vibration and Modal Testing Division of Sandia Laboratories. Modal analysis techniques were used to experimentally determine the modal frequencies, damping, and complex mode shapes of the flywheels in a frequency range corresponding to the purposed operating speed range of the wheels. The wheels were suspended from soft supports during testing so the modes characterize the structures for an unrestrained boundary. Since the complex mode shapes for each modal frequency are best appreciated when viewed on a dynamic display, a special videotape has been prepared to show the first mode shape of the three flywheel configurations. The paper serves as an introduction to and a summary of the videotape and is not intended to be a complete description of the modal analysis work done on the flywheels.

8601 (CONF-790854—, pp 376-386) **High-energy-density flywheel.** Satchwell, D.L. (AiResearch Manufacturing Co. of California, Torrance). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The paper describes the design and fabrication of a flywheel rotor with an energy density of 80 Wh/kg. The design features a multi-ring, S-glass and Kevlar composite material rim that is mounted on a graphite composite spoked hub. Composite material flywheels have been constructed with identical rim design using spoked aluminum hubs. These aluminum hub flywheels have been successfully tested to energy densities of 53 Wh/kg. The use of high strength-to-weight graphite composite material in place of the aluminum material significantly reduces the weight of the rotor assembly and thereby increases the energy density. Graphite epoxy composite is chosen for the hub because of its high modulus of elasticity, because of its light weight, and because of its high ultimate flexural strength. The hub consists of multiple slats, alternately bonded one upon another to form a four-spoke hub with rigid cruciform shape. Hub testing was conducted on three hub sections 19.5 inch dia. by 1 inch thick; and consisted of compression testing across one opposite set of spokes to determine the location, mode, and load at failure. Two hubs were cycled to an increased stress level that is equivalent to a full-life test. Two complete assembled rotors were made available for testing in a following phase.

8602 (CONF-790854—, pp 388-398) **Composite-Laminate Flywheel-Rotor Development Program.** Kulkarni, S.V. (Univ. of California, Livermore). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The composite-laminate flywheel program is being conducted at the Lawrence Livermore Laboratory (LLL) (tapered thickness Stodola rotor concept) and at the General Electric Company (alphaply constant-thickness rotor concept). The major thrust of the FY 1979 LLL program was directed towards identifying the pacing issues and implementing the steps undertaken to improve the performance of the rotor. To that end, the following tasks were initiated: (1) redesigning the Stodola rotor to increase the energy density; (2) testing laminate coupons to establish the degree of strength anisotropy of various quasi-isotropic laminates; (3) spin testing of constant-thickness composite-laminate rotors to establish a relationship between design data and failure speed; (4) developing a matched-metal-die compression-molding process to fabricate thick, high-fiber volume, low-void-content composite panels; and (5) exploring the feasibility of manufacturing low-cost rotors from structural sheet-molding compounds. The progress to date in each of these areas is reported.

8603 (CONF-790854—, pp 400-406) **Laminated flywheel disc with filament wound outer ring.** Nimmer, R.P. (General Electric Co., Schenectady, NY). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

It has been shown that the energy density of a laminated composite flywheel can be improved if an outer ring of unidirectional composite is added to the rotor. In addition, the existence of an optimum thickness for the outer ring which provides maximum energy density has been established. The current work expands upon this basic concept and encompasses the design, fabrication, test and evaluation of such a flywheel as a high energy density, mechanical energy storage unit. Analysis of this design concept has identified failure criteria as well as potential advantages and disadvantages dependent upon material choice. Parametric design studies have been conducted to evaluate the impact of mechanical property variation upon the available energy density. A laminated S2 glass disc with a filament wound, graphite outer ring has been identified as offering the highest potential energy density for this design concept. The hydroclaving technique has been applied to manufacture laminated S2-glass discs with void contents of 1.6%. Computer controlled filament winding has been applied for fabrication of the unidirectional outer rings. Burst tests to date have been conducted on laminated S2-glass discs without outer rings indicating energy densities in the 30 to 40 Wh/kg (15 to 18 Wh/lb) range. Improved material and addition of filament wound outer rings are expected to raise these values.

8604 (CONF-790854—, pp 408-414) **Demonstration of a low cost flywheel in an energy storage system.** Rabenhorst, D.W. (Johns Hopkins Univ., Laurel, MD). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The Applied Physics Laboratory has been engaged for the past eighteen months in a program for the Department of Energy involving the development of very low cost flywheels, such as those which would be used in individual home or factory energy storage systems. A significant part of this program also included the development of low loss, long life bearing systems. The flywheel development explored a number of promising low cost materials and produced flywheel configurations which were projected for a large scale production cost of about $50 per kilowatt hour. While this is comparable to the initial cost of competing lead-acid batteries, it is noted that, unlike the batteries, the flywheel would not have to be replaced several times during the life of the system. The bearing systems evaluated were based upon the use of otherwise conventional ball bearings which were arranged in special configurations so as to minimize their requirements for size and rotation speed. Bearing configurations were demonstrated which exhibited losses of the order of one watt per one hundred pounds of flywheel. The success of this program warrants consideration of proceeding with a full scale system demonstration, based upon the design projections of the subject program.

8605 (CONF-790854—, pp 416-421) **Oak Ridge Flywheel Evaluation Laboratory.** Steele, R.S. (Union Carbide Corp., Oak Ridge, TN). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The final assembly and proof testing of the Oak Ridge Flywheel Evaluation Laboratory (ORFEL) spin test facility has been completed as specified in the FY 1979 goals for the Oak Ridge Y-12 Plant's flywheel program. The spin facility is qualified to test flywheels with energy levels of up to 2 kWh. The comprehensive evaluation of a flywheel design requires that it be subjected to several destructive and nondestructive tests, including detailed quantitative analysis of the test data. The consideration of these requirements is a major feature in the immediate plans of the ORFEL.

8606 (CONF-790854—, pp 424-429) **Army flywheel program.** Heise, C.J.; Amstutz, L.I. (US Army MERADCOM, Fort Belvoir, VA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The paper describes the US Army MERADCOM flywheel program with emphasis on the evaluation of a 30 kWh energy storage module. In this module advanced steel flywheel technology is used to achieve a high energy storage density. The systematic evaluation being undertaken will serve to confirm the design procedures and indicate where changes are needed. The information will be useful in guiding future energy storage systems developments.

8607 (CONF-790854—, pp 432-437) **Application of inertia welding technology to steel disc-type flywheels.** Kerr, D.L. (General Electric Co., Schenectady, NY). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The paper summarizes a program which investigated the feasibility of applying inertia welding to the fabrication of multiple disc, steel flywheel assemblies for transportation application. The program was divided into three phases: Phase I - Establish Inertia Weldability; Phase II - Joint Geometry Considerations; and Phase III - Simulated Flywheel Disc Assembly. It is concluded that inertia welding of certain steel alloys (Hy-Tuf and 4340, for example) is readily accomplished in configurations desired for flywheel applications. Welds are sound and have good short-term tensile properties. Future effort should be applied to evaluating fatigue characteristics, including further study of configurations which might enhance fatigue properties.

THERMAL

REFER ALSO TO CITATION(S) 8314, 8385, 8386, 8582, 8583, 8584, 8588

8608 **Relation between surface temperature and time for a phase change process with a convective boundary condition.** Solomon, A.D. (Union Carbide Corp., Oak Ridge, TN). *Lett. Heat Mass Transfer;* **6**: No. 3, 189-197(May 1979).

The paper presents a simple relation between the wall temperature T/sub wall/ of a semi-infinite phase change material (PCM) slab and the time when this temperature is attained during a melting

process with a convective boundary condition. An example of its use is given for a paraffin wax PCM.

8609 (ORNL/TM—6876) **Preliminary economic analysis of aquifer winter-chill storage at the John F. Kennedy airport.** Fox, E.C.; Thomas, J.F. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 34p. Dep. NTIS, PC A03/MF A01.

A conceptual design was formulated in conjuction with a cost analysis to determine the feasibility of retrofitting the present John F. Kennedy (JFK) airport air-conditioning system with an aquifer cold water storage system. It appears technically feasible to chill and store aquifer water at the airport site during the winter months for later air-conditioning use. However, the economic analysis shows that although a significant energy savings is realized, the money saved from reduced energy costs would not be enough to recover the necessary capital investment over a 20-year period. JFK airport may be a poor economic choice for an aquifer cold water storage demonstration site due to site specific problems, and other sites may provide economic incentive.

8610 (PNL—3062) **Thermal energy storage in aquifers: preliminary information.** Allen, R.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract EY-76-C-06-1830. 86p. Dep. NTIS, PC A05/MF A01.

Topics discussed include: conceptual designs; numerical modelling; field experiments; relevant technical information; feasibility studies; preliminary aquifer selection considerations; and preliminary design and operating considerations. (TFD)

8611 (PNL—3167) **Geochemical equilibrium modeling of the Auburn Thermal Energy Storage Field Test.** Stottlemyre, J.A.; Smith, R.P.; Erikson, R.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 47p. Dep. NTIS, PC A03/MF A01.

The objective of the study was to investigate some alternate reservoir damage mechanisms that may have contributed to the loss of well injectivity experienced at the Mobile field site. Specifically, this includes mineral precipitation and/or alteration resulting from: 1) increased temperatures and temperature gradients, 2) presence of oxygen, 3) fluid-fluid incompatibility (mixing of two different aquifer waters), and 4) fluid-rock imcompatibility (introducing foreign groundwaters into storage aquifer sedimentary matrix). The primary investigatory tool used in the study is an Electric Power Research Institute computer program (EQUILIB), which is based on equilibrium chemical thermodynamics. The computer code was utilized to simulate changes in mineralogy and groundwater chemistries due to the interaction of the sediment material and two differing aquifer waters at temperatures of 55°C, 100°C, and 150°C. Conclusions are primarily based on the 55°C results since this was the maximum operating temperature for the Auburn experiment.

BATTERIES

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 8769, 8823

8612 **Review of industrial participation in the ANL lithium/iron sulfide battery development program.** Gay, E.C.; Miller, W.E.; Malecha, R.F.; Elliott, R.C. (Argonne Natl Lab, Ill). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 690-696(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Lithium/iron sulbide batteries are being developed at Argonne National Laboratory (ANL) for use as power sources for electric vehicles and for stationary energy storage devices for load leveling. An important part of the battery program involves subcontracts with various industrial firms. This paper describes the nature of the industrial participation in the ANL Battery Program and the progress that has been made in the development and fabrication of industrial cells. In order to evaluate cells fabricated by industrial subcontractors, ANL has used automated qualification testing. Present cell development efforts are directed toward improving specific energy and power in the FeS cells and improving cycle life and current collector design in FeS_2.

8613 **Overview of near-term battery developments.** Yao, N.P.; Ludwig, F.A.; Hornstra, F. New York, NY; Electric Vehicle Council (1978). 11p.

The near-germ battery effort, geared to electric vehicle (EV) demonstrations in 1981 to 1984, stresses goals requiring improvements over existing batteries in performance, cycle life, and cost. Argonne National Laboratories in performance, cycle life, and cost. Argonne National Laboratory is managing a number of DOE-sponsored battery R and D subcontracts (nickel/zinc, lead-acid, and nickel/iron systems) requiring the scheduled delivery and testing at Argonne, under uniformly applied conditions, of several improved versions of cells, modules, and batteries. Each contract culminates with the delivery and test of fifteeen 20- to 30-kWh EV batteries in 1980 and 1981. The National Battery Test Laboratory (NBTL) at Argonne includes 500-A fully automated test stations which can independently test full-size EV batteries. The testing capabilities and test results at the NBTL are discussed. Subcontractor R and D efforts to date are presented and analyzed. The confidence level in achieving program goals is high. 3 figures, 4 tables.

PERFORMANCE AND TESTING

8614 **Advances in the development of lithium-aluminum/metal sulfide cells for electric-vehicle batteries.** Martino, F.J.; Kaun, T.D.; Shimotake, H.; Gay, E.C. (Argonne Natl Lab, Ill). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 709-716(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Recent advances at Argonne National Laboratory (ANL) in the development of lithium-aluminum/metal sulfide cells for electric-vehicle batteries are described. This battery has demonstrated the potential to produce higher specific energy (more than 150 Wh/kg) and higher specific power (more than 200 W/kg) required for use in electric automobiles than commercially available batteries. The first 40 kW-hr lithium-aluminum/metal sulfide electric-vehicle battery is to be tested in a van at ANL in early 1979.

MATERIALS, COMPONENTS, AND AUXILIARIES

8615 **Cylindrical electric cell.** Touchard, R. (to SAFT - Societe des Accumulateurs Fixes et de Traction). US Patent 4,127,704. 28 Nov 1978. Priority date 18 Apr 1977, France, 4p.

A cylindrical electric cell includes at least one positive electrode, at least one negative electrode disposed coaxially with respect to the positive electrode, and a device for maintaining the distance between these electrodes during discharge. In accordance with the invention, the device is constituted by the combination of a cylinder constituted by practically inextensible wires braided helically and by a spring which maintains this braid resiliently applied against the innermost or the outermost electrode of the electric cell.

8616 **Composite solid electrolyte body.** Dunn, B.S. (to General Electric Co.). US Patent 4,124,744. 7 Nov 1978. Filed date 17 Nov 1977. 4p.

A composite body is described which comprises a body of solid ion-conductive electrolyte material, the body having a casing portion with one open end and a header integral with the casing adjacent its open end, and a surface portion of an ion-insulating material on only the exterior surfaces of the header portion of the body. A method of forming such a composite body is also described.

8617 **Method of treating low antimony alloy battery grid material with phosphorus.** Nees, J.; Pike, K. (to General Battery Corp.). US Patent 4,113,476. 12 Sep 1978. Filed date 20 Oct 1976. 4p.

A novel method is provided wherein the grain structure and castability of low-antimony lead battery grid alloy is improved by treating that alloy with trace amounts of phosphorus, and more particularly red phosphorus.

8618 **Galvanic cell with negative zinc electrode and a bivalent silver oxide positive electrode and method for its manufacture.** Lippold, H.M.; Spahrbier, D. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,506,399/B/. 3 May 1978. 9p. (In German).

Silver-zinc cells in which the bivalent silver oxide is reduced at its surface in such a manner that the cell has the discharge voltage of the Ag_2O/Zn system are improved upon according to the invention by insulating the bivalent silver oxide from the positive conductor by an electron-nonconducting plastic layer. The electronic contact of the bivalent silver oxide to the conductor takes place via a porous silver layer facing the opposite electrode and which is connected via a porous layer of monovalent silver oxide to the 2-valent silver oxide. The porous silver layer is connected to the conductor by means of a metallic contact.

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 8816

8619 (ANL-PMS—79-2(Vol.1)) **World Energy Data System (WENDS). Volume I. Country data, AF-CO.** (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 345p. Dep. NTIS, PC A15/MF A01.

The World Energy Data System contains organized data on those countries and international organizations that may have critical impact on the world energy scene. Volumes 1 through 4 include

energy-related information concerning 57 countries. Additional volumes (5 through 11) present review information on international organizations, summaries of energy-related international agreements, and fact sheets on nuclear facilities. Country data on Afghanistan, Algeria, Argentina, Australia, Austria, Bangladesh, Belgium, Bolivia, Brazil, Burma, Canada, China, and Colombia are included in Volume 1. The following topics are covered for most of the countries: economic, demographic, and educational profiles; energy policy; indigenous energy resources and uses; forecasts, demand, exports, imports of energy supplies; environmental considerations; power production facilities; energy industries; commercial applications of energy; research and development activities of energy; and international activities.

8620 (ANL-PMS—79-2(Vol.2)) **World Energy Data System (WENDS). Volume II. Country data, CZ-KS.** (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 361p. Dep. NTIS, PC A16/MF A01.

The World Energy Data System contains organized data on those countries and international organizations that may have critical impact on the world energy scene. Included in this volume, Vol. II, are Czechoslovakia, Denmark, Egypt, Finland, France, Germany (East), Germany (West), Greece, Guinea, India, Indonesia, Iran, Italy, Japan, and Korea (South). The following topics are covered for most of the countries: economic, demographic, and educational profiles; energy policy; indigenous energy resources and uses; forecasts, demand, exports, imports of energy supplies; environmental considerations of energy use; power production facilities; energy industries; commercial applications of energy; research and development activities of energy; and international activities.

8621 (ANL-PMS—79-2(Vol.3)) **World Energy Data System (WENDS). Volume III. Country data, LY-PO.** (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 364p. Dep. NTIS, PC A16/MF A01.

The World Energy Data System contains organized data on those countries and international organizations that may have critical impact on the world energy scene. Included in this volume, Vol. III, are Libya, Luxembourg, Malaysia, Mexico, Netherlands, New Zealand, Niger, Nigeria, Norway, Pakistan, Peru, Philippines, Poland, and Portugal. The following topics are covered for most of the countries: economic, demographic, and educational profiles; energy policy; indigenous energy resources and uses; forecasts, demand, exports, imports of energy supplies; environmental considerations of energy supplies; power production facilities; energy industries; commercial applications of energy; research and development activities of energy; and international activities.

8622 (ANL-PMS—79-2(Vol.4)) **World Energy Data System (WENDS). Volume IV. Country data, SG-YO.** (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 407p. Dep. NTIS, PC A18/MF A01.

The World Energy Data System contains organized data on those countries and international organizations that may have critical impact on the world energy scene. Included in this volume, Vol. IV, are Senegal, South Africa, Soviet Union, Spain, Sweden, Switzerland, Taiwan, Tanzania, Thailand, Turkey, United Kingdom, United States, Upper Volta, Venezuela, and Yugoslavia. The following topics are covered for most of the countries: economic, demographic, and educational profiles; energy policy; indigenous energy resources and uses; forecasts, demand, exports, imports of energy supplies; environmental considerations of energy supplies; power production facilities; energy industries; commercial applications of energy; research and development activities of energy; and international activities.

8623 (ANL-PMS—79-2(Vol.5)) **World Energy Data System (WENDS). Volume V. International organization data.** (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 156p. Dep. NTIS, PC A08/MF A01.

The World Energy Data System contains organized data on those countries and international organizations that may have critical impact on the world energy scene. WENDS has acquired and organized information on the following energy-related organizations: Asian Development Bank; European Economic Community; Inter-American Development Bank; International Atomic Energy Agency; International Energy Agency; Nuclear Energy Agency; United Nations; and World Bank. Within each organizational grouping most of the following topics are addressed: organization background, government background, energy background (energy policy and objectives), energy research and development activities, and international activities.

8624 (CONF-790202—) **Energy and the public: public awareness workshop and plenary session.** (Oak Ridge National Lab., TN (USA)). Jul 1979. Contract W-7405-ENG-26. 280p. Dep. NTIS, PC A13/MF A01.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

This publication of these two sessions of the conference on February 22 and 23, 1979 was prepared from a verbatim record made by a reporting firm. A separate abstract was prepared for each of the seventeen papers of the public awareness workshops and of the six papers of the plenary session.

8625 **Second Lawrence symposium on systems and decision sciences.** North Hollywood, CA; West Period Co. (1978). 348p. (CONF-781005—).

From 2. symposium on systems and decision sciences; Berkeley, CA, USA (2 Oct 1978).

The Second Lawrence Symposium on Systems and Decision Sciences consists of 40 papers, abstracted separately, organized into three themes: Large Scale Models and Planning, Information Utilization, and Large Scale Systems Theory. Applications to energy problems and issues were emphasized as appropriate.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 8625, 8636, 8657, 8660, 8661, 8720, 8805

8626 (DOE/EIA—0183/13) **Ex-post comparison of the performance of the 1973 version of the Project Independence Evalaution System.** Rodekohr, M.; Murphy, F. (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1979. 27p. Dep. NTIS, PC A03/MF A01.

This paper presents an ex-post comparison of actual and predicted energy production and consumption for 1977. The comparison centers on a large energy-forecasting model formerly known as the Project Independence Evaluation System (current version known as the Mid-Range Energy Forecasting System) as described in the Project Independence Report published in 1974. This comparison centers on energy consumption and production. It not only compares the actual and forecasted values of these variables, but examines the underlying assumptions pertaining to the exogenous variables used in the PIES forecast. As reported in the Project Independence Report, the 1977 values for the Dupree-West forecast are, for the most part, interpolations taken from the Dupree-West 1980 forecast. Since this is the only nonmodel-derived forecast for 1977, however, it remains useful in making this comparison. It is also important to note that the Dupree-West forecast was made prior to the oil embargo of 1974. For comparative purposes, the $11/bbl, business-as-usual, no conservation, PIES case is used exclusively in this analysis. (MCW)

8627 (DOE/EIA—8558-3) **Integrating Model of the Project Independence Evaluation System. Volume III. User's Guide.** Shaw, M.L.; Hutzler, M.J. (Logistics Management Inst., Washington, DC (USA)). Mar 1979. Contract EC-77-C-01-8558. 70p. Dep. NTIS, PC A04/MF A01.

Volume III of the six-volume series documenting the Integrating Model of PIES provides a potential PIES user with a description of how PIES operates with particular emphasis on the possible variations in assumptions and data that can be made in specifying alternative scenarios. PIES is described as it existed on January 1, 1978. The introductory chapter is followed by Section II, an overview of the structure and components of PIES. Section III discusses each of the PIES components in detail; describes the Demand Model; contains a description of the models, assumptions, and data which provide supply side inputs to the PIES Integrating Model; and concludes with a discussion of those aspects of PIES which extend the scope of the analysis beyond the national energy market. Section IV discusses two reports produced by the PIES Integrating Model: the PIES Integrating Model Report and the Coal Transportation Report. (MCW)

8628 (SERI/RR—51-332) **Proposition on energy analysis and economic efficiency.** Hertzmark, D.I. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1979. Contract EG-77-C-01-4042. 22p. Dep. NTIS, PC A02/MF A01.

This report gives some analytical results of an attempt to simultaneously optimize economic and thermodynamic efficiency. The attempt to impose complete mathematical rationality and consistency on the pricing of energy commodities fails since it is not possible to consistently weigh purely physical efficiency measures, much less social factors. This means that energy or entropy theories of value must suffer the fate of other single-factor theories, such as the labor theory of value. Such a single-factor theory cannot adequately handle such questions as fixed capital, subjective utility, and contradictory constraints on economic choice. Nevertheless, the use of both material balance and entropy analysis is valuable for evaluating nonmarket decisions, as well as identifying opportunities for process improvements. That is, economic and thermodynamic analyses are complementary in that they ask different types of questions and express the answers in noncomparable dimensions. This comple-

mentarity is a type that avers that each mode of analysis asks different questions from different perspectives. 17 references.

8629 **Energy modeling: building understanding for better use.** Hogan, W.W. (Harvard Univ, Cambridge, Mass). pp 1-10 of Second Lawrence symposium on systems and decision sciences. North Hollywood, CA; West Period Co. (1978).

From 2. symposium on systems and decision sciences; Berkeley, CA, USA (2 Oct 1978).

Energy modeling for policy analysis is expanding, and the critical review of the models is underway. The model evaluation process can be designed to contribute to the better understanding of the models, leading to better use in policy applications.

8630 **Energy models in the policy process: oil price decontrol and synthetic fuels commercialization.** Weyant, J.P. (Stanford Univ, Calif). pp 11-30 of Second Lawrence symposium on systems and decision sciences. North Hollywood, CA; West Period Co. (1978).

From 2. symposium on systems and decision sciences; Berkeley, CA, USA (2 Oct 1978).

This paper addresses the question of the extent to which quantitative models have been used in the formulation of energy policy. Two cases from the 94th Congress are examined: the oil price decontrol debate and the synthetic fuels commercialization analysis. The use of the Project Independence Evaluation System (PIES) and the DRI macroeconomic model in the oil price decontrol debate are described. The influence of this work on the congressional debate and resulting legislation is then traced.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 8624, 8628, 8637, 8638, 8650, 8655, 8657, 8688, 8697, 8718, 8722, 8723, 8724, 8725, 8781, 8812, 8813, 9268

8631 (CONF-790202—, pp 109-128) **Energy costs to the consumer: an examination of the reasons for rising prices.** Talley, W.W. Jr. Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

An examination of energy end-use patterns and price trends, focusing on the Southeast, indicates that the Sunbelt region will bear the major impact of proposed energy regulations. The argument is made for using research money to pay the cost of producing existing energy resources, combined with planning for an appropriate energy mix and acceptable energy applications. The premise that everyone should pay for the actual (marginal) cost of electricity must be accepted. Fuel costs, supply uncertainties, unrealistic demands of conservationists and environmentalists, capacity expansion, labor, and the bond market are all contributing to rising power costs. Each is the result of actions taken by elected representatives and can be changed if citizens take the responsibility for working with Washington to make the necessary adjustments.

8632 (CONF-790202—, pp 129-134) **Impacts of the National Energy Act on supply and cost.** Vlcek, J. (Gardner, Carlton, and Douglas, Washington, DC). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Each of the National Energy Act's (NEA) five separate acts is described in terms of its major provisions and its impact on the supply and cost of energy. Some positive accomplishments are seen in the elimination of an artificial market distinction between intra- and interstate gas supplies, the thrust (though superficial) toward developing domestic coal resources, and the thrust (though limited) toward conservation. The negative impacts, however, encourage supply uncertainty and result in confusing signals from the government. These uncertainties, coupled with the conflict of NEA's goals with those of other environmental and regulatory legislation, increase fuel costs. A national energy act is recommended that is based on certainty, unified goals, simplicity, incentives, and an appropriate focus for energy technology research.

8633 (CONF-790202—, pp 251-259) **Energy and social change.** Boulding, K.E. Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Energy for production is one of five vital necessities, the others being know-how, materials, space, and time. This energy must be present in the righr quantity and form in order to produce the desired societal good. Selecting the good, which is basically a question of value, can employ the processes of marketing pricing, politics, and moral order to economize agreement. The intermediaries of production are things, organizations, and personal artifacts, with energy the limiting factor for each. Gains in knowledge in such fields as meteorology and the acceptance of new ways of looking at things are needed to replace a reliance on projections from big technology. Professor Boulding feels that human ingenuity can provide many of the answers for future energy supplies and that it can be applied to weld together a more cooperative international system.

8634 (CONF-791009—17) **Comparison of impacts of heating alternatives on minority employment for northern US cities.** Santini, D.J.; Hoover, L.J.; Stenehjem, E.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

This paper examines minority employment effects that result from construction of alternative energy facilities designed to serve the same final heating demand. The comparison specifically focuses on heating services to the center cities of major northern US metropolitan areas. District heating by cogeneration is compared to coal gasification, liquefaction, and electrification. It is shown that significant differences in minority employment will result from differences in placement of capital stock. The district-heating system places a much higher proportion of its capital structure within the actual urban service area than do the three alternative technologies. In view of the concentration of minority populations in these urban areas, a substantially greater amount of minority employment will occur if the district-heating technology is implemented. The district-heating system also requires relatively lower occupational skills than do the two alternative technologies. Since minorities are more often in the low-skill occupational categories, the district-heating technology offers more employment opportunity for minorities. Other positive employment effects of the cogeneration alternative are also noted.

8635 (DOE/ET—0114/1) **Report of the alcohol fuels policy review. Raw material availability reports.** (SRI International, Menlo Park, CA (USA)). Sep 1979. Contract EJ-78-C-01-6665. 425p. Dep. NTIS, PC A18/MF A01.

The purpose of this study was to support the US Department of Energy's Alcohol Fuels Policy Review effort by identifying US regions containing significant amounts of agricultural residues and municipal solid wastes as possible feedstocks for conversion to alcohol fuels. Emphasis was placed on the regional estimation of feedstock quantities, the cost of feedstock acquisition, energy balances, and institutional effects of a federal alcohols program. The availability and cost of feedstocks suitable for the production of alcohol fuels are crucial factors insofar as project feasibility is concerned. In this report, SRI analyzes two potential feedstock sources: agricultural residues and municipal solid waste (MSW). These feedstocks result from ongoing production and consumption activities in all regions of the country, and the amount of the residues produced is only minimally tied to economic fluctuations (although changing weather patterns affect supply). The abundance of the residues by location is also a function of agricultural activity and productivity, in the case of agricultural residues, and population base, in the case of MSW. Although these residues result from continuing production and consumption activities, their use as an alcohols feedstock is limited by several economic considerations. The most abundant of the agricultural residues are seasonal and are currently used for their nutrient properties by the agricultural sector. Diverting these residues for energy use will require changes in current agricultural practices and provision of other nutrients for the soil. MSW, currently disposed of at a cost, does not come in a form suitable for an energy feedstock; transforming MSW into suitable feedstock quality will require some expense. Separate abstracts were prepared for the 5 appendixes.

8636 (DOE/TIC—10282) **Basic user's guide to social and economic models and methodologies for energy impact assessment.** Peterson, D.L.; Meeks, G. Jr.; Scrimgeour, D.P.; Wanush, M.A. (Quality Development Associates, Inc., Denver, CO (USA)). Oct 1979. 65p. Dep. NTIS, PC A04/MF A01.

Decisions must be deliberated and made, and strategies for action developed and pursued regarding mitigation of impacts of energy development. No single community will approach the problem of social- and economic-impact assessment exactly like any other community. An array of strategies, frameworks, methodologies, and models have been formulated and proposed to help local officials and citizens assess and respond to problems associated with energy exploration, extraction, processing, and utilization. These techniques are discussed and 18 methodologies and models are included.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 8006, 8046, 8062, 8224, 8445, 8659, 8699, 8712, 9058, 9061, 9064, 9218, 9339

8637 (CONF-790202—, pp 163-181) **Comparative risks in energy production.** Silver, E.G. (Oak Ridge National Lab., TN). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Dr. Silver discusses primarily a study completed in 1978 by Dr. Herbert Inhaber (Atomic Energy Control Board, Ottawa, Canada) of the relative societal and economic risks of eleven energy sources. Inhaber covered coal, oil, nuclear, natural gas, hydroelectric, wind, methanol, three types of solar (space heating, solar thermal, and photovoltaic), and ocean thermal gradients in his report. The study examined each source, considering energy material input per unit of energy derived, and examined each risk separately and then collectively to arrive at a comparative figure for deaths (in which death is equated to 6000 man-days or 20 years of work), lost-time accidents, and disease in terms of unit time. Coal and oil were found to have greater risks in this context than nuclear, which was slightly higher than natural gas. Nonconventional systems have higher risks than nuclear because of the larger amounts of material involved. Dr. Silver used 12 slides in discussing the study which resulted in a great number of questions from the audience.

8638 (CONF-790202—, pp 235-250) **Different constraint on energy systems.** Rotty, R. (Inst. for Energy Analysis, Oak Ridge, TN). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

The environmental effects of global energy demand and global energy use are examined in respect to the release of carbon dioxide (CO_2) over time. Data from 1948 show a steady increase in CO_2 concentrations in the atmosphere and reflect the presence of an annual cycle which has a biological basis. Measurements of the CO_2 buildup and its impact on climate indicate that there are temperature increases for the lower latitudes and a significant change in the temperature gradient from the equator to the pole. The implications that changing weather and food production patterns will have for socio-economic and political structures are examined in terms of the energy needed for a growing world population and the economic development of Third World countries.

8639 (CONF-791009—19) **Environmental assessment of the utilization of alcohol fuels in highway vehicle applications.** Bevilacqua, O.M.; Bernard, M.J. III. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 11p. Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The need to conduct a comprehensive environmental assessment of the utilization of alcohol fuels in highway-vehicle applications has been accelerated by the recent growth in the use of alcohol and gasoline blended fuels. Fundamental to the assessment is the specification of the type of alcohol fuels that will be used in the future, and the manner and extent to which these alcohol fuels will be used. This paper describes four alternative alcohol-fuel-utilization scenarios and how they were derived. The development of the utilization scenarios was based on an evaluation of a broad range of implementation constraints and considerations. The final set of utilization scenarios will be used in the environmental assessment to bracket the probable environmental impacts and implications during the foreseeable future.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 8049, 8656, 8806, 8807, 8808

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 8010, 8011, 8233, 8715, 8716, 8793

8640 (CONF-790202—, pp 91-95) **Alternative energy projects for community self-reliance.** Barlow, H. (Inst. for Local Self-Reliance, Washington, DC). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

The search for appropriate technologies which communities can apply to indigenous energy resources is combined with community development schemes to increase self-reliance. The Institute for Local Self-Reliance thinks in terms of conserving as well as exploiting renewable resources. The Institute is concerned with scale and equity in addition to the basic goal of affordable energy. Experience indicates that people are more likely to conserve energy if they are also energy producers and are personally involved in the energy flow. Citizens awareness expands from local projects to a better understanding of the broad issues and a position of questioning how a community manages its resources and capital. The role for those with technical expertise is to respond to the concerns expressed at public policy forums and to help interpret the interdependence aspects of appropriate technology in terms of community development.

8641 (NCEI—0004) **North Carolina Energy Institute: 1979 annual report.** Bresee, J.C. (North Carolina Energy Institute, Research Triangle Park (USA)). 14 Sep 1979. 132p. NTIS, PC A07/MF A01.

Progress at the North Carolina Energy Institute is reported. Research status and funding of 18 projects are briefly discussed. The projects which received Institute contracts are: energy conservation in the production and use of residential environment: building industry and consumer prospectives in NC; fuel gas for NC industries; development of simplified model for estimating energy usage by commercial and institutional buildings in NC; solar energy applications to wastewater management facility; a geochemical exploration program for uranium in the northern Wadesboro and southern Sanford Triassic Basins of NC; polarization and compromise in energy policy; thermophilic methane production from poultry waste: from the laboratory to the farm; geophysical exploration of coal and gas resources associated with a buried Triassic Basin in the NC Coastal Plain; model solar home for demonstration and consumer studies; coal environmental research project; changing rates of solar biomass energy accumulation in NC Piedmont forests; feasibility of using NC peat for firing bricks; evaluations of potential for cogeneration of electricity and process heat in NC; demonstrate the usefulness of NC olivine in heat storage bricks; utilization of solar energy in grain drying; applications of solar heating technology to a batch-type industrial process; the availability of solar energy in NC; and a study of chimney draft regulation relating to energy conservation in oil-burning residential furnaces.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 8146, 8467, 8495, 9268, 9506

8642 (CONF-790202—, pp 5-8) **Nuclear reactor safety.** Buhl, A.R. (Nuclear Regulatory Commission, Washington, DC). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Dr. Buhl feels that nuclear-energy issues are too complex to be understood as single topics, and can only be understood in relationship to broader issues. In fact, goals and risks associated with all energy options must be seen as interrelated with other broad issues, and it should be understood that there are presently no clearcut criteria to ensure that the best decisions are made. The technical community is responsible for helping the public to understand the basic incompatibility of hard and soft technologies and that there is no risk-free energy source. Four principles are outlined for assessing the risks of various energy technologies: (1) take a holistic view; (2) compare the risk with the unit energy output; (3) compare the risk with those of everyday activities; and (4) identify unusual risks associated with a particular option. Dr. Buhl refers to the study conducted by Dr. Inhaber of Canada who used this approach and concluded that nuclear power and natural gas have the lowest overall risk.

8643 (CONF-790202—, pp 9-11) **Clinch River Breeder Reactor.** Baron, S. Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Mr. Baron says the administration's effort to terminate the Clinch River Breeder Reactor (CRBR) project is symptomatic; they have also placed restrictions on fusion, coal, solar, and other areas of energy development in which technological advances are held back in order to force conservation. Because the breeder reactor, unlike solar and fusion energy, is both economically and technically feasible, a demonstration plant is needed. The contentions that the CRBR design is obsolete, that its proposed size is inappropriate, or that plutonium can be diverted for weapons proliferation are argued to be invalid. Failure to complete the CRBR will have both economic and national security repercussions.

8644 (CONF-790202—, pp 13-17) **Nuclear wastes.** Graham, J. (American Nuclear Society, Washington, DC). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

The imprecise terminology used to describe and define nuclear wastes has caused distortions and confusion in the public mind. High-level defense wastes are the major problem, one which many engineers feel has technically feasible solutions and which must be dealt with irrespective of the nuclear power problem. The engineers, however, are unable to reach a consensus on how wastes should be handled because of the varied orientations of their engineering

backgrounds. They disagree on whether there is time to explore a range of waste-disposal options and on the cost and risk implications of these options. They question the need for the government to license itself to handle its own defense wastes. Plutonium poisoning from high-level wastes is a myth because the plutonium has been separated from high-level wastes and because, as a heavy metal, it is not readily ingested or digested.

8645 (CONF-790202—, pp 151-161) **How nuclear power plants work.** Price, T.C. (Tennessee Valley Authority, Knoxville). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Existing and proposed nuclear power plants in the Tennessee Valley are reviewed. Mr. Price outlines the basics of pressurized-water and boiling-water reactors. Nuclear power is compared with coal power in terms of the volume of fuel required and the waste products associated with the two kinds of plants. Slides illustrate the fission process and the design used for the Sequoyah nuclear plant. Schematic drawings are used to illustrate the containment in a pressurized water reactor and the zone separation plan of a nuclear plant.

8646 (EPRI-NP—1190-SR) **EVAP users manual.** Heising, C.D.; James, J. Jr. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1979. 47p. Dep. NTIS, PC A03/MF A01.

The computer code EVAP calculates the national economic value of an advanced electric power system - in particular, the liquid metal fast breeder reactor - under conditions of uncertainty in electricity demand and availability of technologies. On the basis of this calculation and assumptions about the effects of various reprocessing decisions on the availability of the advanced system, the code can also calculate the value of alternative reprocessing decisions. Uncertainties in the data are treated explicitly through the construction and evaluation of a Bayesian decision-analysis economic model (a decision tree). EVAP is short (400 lines of FORTRAN) and quick running (3 seconds of processing time on the Electric Power Research Institute's [EPRI's] PRIME-450 minicomputer).

8647 (INIS-mf—4780) **Education and public acceptance of nuclear power plants.** Delcoigne, G. (International Atomic Energy Agency, Vienna (Austria)). 1978. 16p. (CONF-781022—65). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

After a short review of the origins of the nuclear controversy in the United States, its spread in recent years in Europe and in North America will be examined. The situation in Eastern Europe and less industrialized countries will also be analysed, as well as the ups and downs of some of the arguments. Some of the effects and consequences which have arisen on a national level and possible lessons for the future will be drawn, both at national and international levels.

8648 (INIS-mf—4781) **Formation of public attitudes to nuclear power.** Holy, Z.J.; Innes, R.W. (New South Wales Univ., Kensington (Australia). School of Nuclear Engineering). 1978. 11p. (CONF-781022—69). New South Wales Univ., Kensington (Ausralia). School of Nuclear Engineering.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

Nuclear power has been plagued by public acceptance problems. Evidence suggests one of the key factors is poor communicaton between the scientific community and the general public. Although environmental enquiries provide a forum for the voicing of views, by adopting the adversary principle they have also resulted in polarizaton of public opinion, as experienced in Australia with the Ranger Environmental Enquiry. The problem of developing methods to enable a flow of objective informaton to and from the public requires urgent solution.

8649 (INIS-mf—4806) **Decree No. 77-1233 of 10 November 1977 setting up a Council for information on nuclear electricity generation.** 1977. 1p. (In French). Dep. NTIS (US Sales Only), PC A02/MF A01.

This Decree sets up a Council for information on nuclear electricity generation directly under the authority of and appointed by the Prime Minister. It has 18 members who include, inter alia, mayors of the communes concerned by nuclear power plant siting, representatives of nature and environmental protection associations, science academicians and economics, energy and communications experts. The Council's purpose is to ensure that the public has access to infomation on nuclear electricity generation from the technical, health, ecological, economic and financial viewpoints. It advises the Government on the public's conditions of access to information and proposes methods for its dissemination.

8650 **Socially responsible energy futures.** Starr, C. (Electric Power Research Inst., Palo Alto, CA). *Electr. Perspect.;* No. 3, 1-7(1979).

After examining briefly the usual positions of nuclear critics and nuclear proponents, Dr. Starr says that the proponents (of whom he is one) have a broader case for nuclear power not thus far effectively advanced - a case based chiefly on a visible concern with social values and the future welfare of humanity. Such a broader case for nuclear power has always existed - a case based on motivations that initially spurred development of this energy resource over the past several decades, but one that has tended to be neglected in the public debate. A concern to avoid worldwide catastrophe is central to this broader case for nuclear power. The threat is perceived as resulting directly from the pending unavailability of petroleum and natural gas at a reasonable cost. This unavailability could lead to global tensions and political instabilities, economic crises, and, ultimately, to military conflicts based on need to obtain and control liquid-fuel resources. It is felt that past history and current events substantiate the threat inherent in the international struggle for raw materials. The broader - and more compelling - case for nuclear power lies in its potential for removing a major threat to the peace, stability, and welfare of the world that is inherent in the growing scarcity of petroleum and natural gas resources and in the limited geographical availability of coal. The catastrophe that could be avoided is at least as threatening as the one projected by those who oppose the use of nuclear power, and, Dr. Starr argues, more realistic in its potential for world-shattering impacts.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 8781, 8784

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 8434, 8634, 8799, 8810, 8812, 8813, 8814

8651 **Can district heating be economically transmitted via latent heat.** Bachl, H. (Muenchen Univ. (Germany, F.R.)). *Fernwaerme Int.;* **8**: No. 3, 103-106(Apr 1979). (In German).

District-heating transmission presents a different problem in the use of a double-medium process from that in refrigeration. So far two methods have become known for district-heating transmission via latent heat, and these differ by the extent of use of regenerative heat-exchangers. The author describes both methods and investigates the economic outlook for their application. By the use of heat-storage devices it is possible to achieve high utilisation figures for the power station and for the cold lines.

CONSERVATION

REFER ALSO TO CITATION(S) 8640, 8686, 8772, 8780, 8784, 8786, 8789, 8790, 8793, 8799, 8805, 8806, 8807, 8808, 8810, 8812, 8813

8652 (CONF-790202—, pp 211-233) **Energy conservation: do for ourselves of be done for.** Gibbons, J.H. Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Energy supply and demand options were found by forecasters to be rooted in considerations of real-cost price. A history of cheap energy provides us with many opportunities to reduce costs by improving the efficiency and management of existing capital stock. Carefully chosen changes in energy productivity can be shown to promote economic progress by reducing the total costs of goods and services. Examples from the three major energy-consuming sectors - building, industry, and transportation - illustrate the benefits of front-end capital improvements made within certain natural-law, economic, and technological limits. The opportunity to substitute ingenuity for resources is an important factor. Conference speakers were questioned on the subjects of energy investments, subsidies, land use, forecasting, and risks.

8653 (LBL—9939) **Basic research needs in energy conservation.** Hollander, J.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 28dp. Dep. NTIS, PC A03/MF A01.

The role of research in energy conservation, the role of government in conservation research and the role of basic research in conservation are discussed with information on the need for research on the physical, environmental, social, and economic aspects of energy conservation in the residential industrial, and transportation sectors, and the outlook for US energy supply and demand. (LCL)

8654 **Substitute fuels from renewable and nonrenewable resources: a discussion for the Asia-Pacific region.** Babu, S.P.; Seay, J.G. Chicago, IL; Institute of Gas Technology (1979). 19p. (CONF-7909108—1).

From Workshop on the future of large-scale energy systems; Honolulu, HI, USA (16 Sep 1979).

The world nations, have in general, inadequately explored and under-utilized nonrenewable fuels (e.g., coal, oil shale, and uranium) resources and renewable fuels (e.g., forest and crop residues). It is proposed to use these fuels as transition sources of energy until adequate alternatives for the present conventional fuels are developed and commercialized. This paper discusses the availability and potential of the global resources of transition fuels, the available technology to produce substitute fuels, and an assessment of the cooperative research and development needed to transform projections into practice. Estimates of fuel resources (coal, natural gas, petroleum, shale oil, and uranium) remaining and recoverable are tabulated. Data on energy consumption are also included. (DC)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 8092, 8624, 8626, 8627, 8631, 8632, 8633, 8679, 8682, 8689, 8694, 8705, 8806, 8807, 8808

8655 (CONF-790202—, pp 135-139) **State and regional perspective on energy supply and demand.** Spitzer, E.J. Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

The energy supply and demand situation in Tennessee is described as unique because there is no public service commission with jurisdiction over the Tennessee Valley Authority (TVA), a situation which eliminates some of the political decisions affecting other utilities. While TVA is able to make its own decisions about rates, Mr. Spitzer expresses concern for the energy oasis developing in the Valley with expanding coal-fired and nuclear power. National decisions about natural gas, oil entitlements and equalization, mandatory scrubbers, and other matters consistently favor the Northeast to the point where that region is virtually regulating the South, he says. Mr. Spitzer also evidences concern that the Federal Energy Regulatory Commission could demand that TVA sell power outside its district, which could jeopardize industrial development and force the Southeast to become a power exporter to the Northeast.

8656 (CONF-790202—, pp 187-196) **Energy issues and public acceptance.** Peterson, R.W. (Office of Technology Assessment, Washington, DC). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Dr. Peterson says that, with the era of cheap and abundant energy drawing to a close, alternative options and their costs must become accepted in the next 20 years or the country will suffer serious disruptions. The reluctance to accept energy realities is traced to the coincidence of technological breakthroughs at a time when the oil frontier is closing; the convenience of oil and natural gas compared to their alternatives; and an inclination to postpone decisions until there is a crisis. Decisions must be made now to accept incremental pricing, begin replacing energy-intensive equipment, and reverse the standards and policies which encourage energy consumption. Priorities must also be set on how much to increase energy production at the expense of environmental protection and future energy supplies. The choices associated with the major options - coal, nuclear, and solar - are summarized. Questions from the audience were concerned with solar rights, subsidies, transportation fuels, and shale oils.

8657 (CONF-790202—, pp 197-210) **Energy supply options: economics and implementation.** Hoffman, K.C. (Brookhaven National Lab., Upton, NY). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

The costs of energy alternatives to oil and the times needed for a transition to these options are reviewed in terms of their resource potential and projections of demand and economic analyses. The history of fuel substitutions indicates that new systems and resources have needed at least 50 years to capture a major market share. Energy modeling is used to map future energy demand and energy-source mixes, using a long-term goal of reliance on two nonrenewable resources (nuclear and fossil) and one-third renewable (solar). Energy flows are used in a Reference Energy System to depict end-use consumption patterns and the probable replacement costs of these technologies, each of which needs to be seen in the context of its impact on the overall energy system as well as examined separately. A case for optimism is seen in the number of options available to the US; for pessimism in the price tags attached. Questioners challenged the omission of fusion energy as an option, price calculations, and projections of solar utilization.

8658 (CONF-790973—1) **Energy futures and the concerned person.** Trauger, D.B. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From Knoxville Technical Society meeting; Knoxville, TN, USA (10 Sep 1979).

The energy situation from a global viewpoint is examined. Then the basis for the energy crisis is considered. Some aspects of energy supply from various sources are discussed, and the present energy use and availability of the three worlds are examined. The grouping of the three worlds are presented as the developed democratic countries, the Communist-Socialist countries grouped together in Eastern Europe and Asia, and the developing countries. These are mainly social and economic definitions, but there is relevance in the geography since the first and second worlds lie largely in temperate zones and the third world is more tropical. In discussing the economic/political/resource pressures, Dr. Trauger points out that the first world total energy consumption is about 60%, whereas the two billion people of the third world must function with a very meager energy supply. He feels that one way to relieve these pressures is proper use of high-technology energy sources in the developed countries. For the US he suggests: (1) a vigorous conservation program; (2) develop all potentially attractive energy systems to relieve the pressure on oil; (3) reserve liquid fuels for transportation; and (4) use other forms of energy for electric power production and for energy.

8659 (CONF-7811151—) **Energy and the environment: needs and constraints.** (Ontario Research Foundation, Sheridan Park (Canada)). 1978. 112p. Dep. NTIS (US Sales Only), PC A06/MF A01.

From Symposium on energy and the environment - needs and constraints; Mississauga, Ontario, Canada (7 Nov 1978).

Nine papers were presented at the Symposium, namely: Energy Needs in Canada to Year 2000, C.H. Smith; Environmental Constraints on Energy Production and Distribution, R.W. Durie; Energy and Environment: a Global Perspective, R.J. Uffen; Economics, Energy and the Environment, J. Kyle; Energy, Management in the Forest Products Industry, J.W. Hodgins; Environment, Energy and the Steel Industry, A.J. Harris; Energy, Environment and Power Generation in Canada, W.G. Morison; Renewable Sources of Energy in Canada, J. Hollins. The Luncheon Address was given by Premier William Davis. (MCW)

8660 (DOE/EIA—8558-6/1(Vol.6)) **Integrating model of the Project Independence Evaluation System. Volume VI. Data documentation. Part I.** Allen, B.J. (Logistics Management Inst., Washington, DC (USA)). Feb 1979. Contract EM-77-C-01-8558. 300p. Dep. NTIS, PC A13/MF A01.

This documentation describes the PIES Integrating Model as it existed on January 1, 1978. This volume contains two chapters. In Chapter I, Overview, the following subjects are briefly described: supply data, EIA projection series and scenarios, demand data and assumptions, and supply assumptions - oil and gas availabilities. Chapter II contains supply and demand data tables and sources used by the PIES Integrating Model for the mid-range scenario target years 1985 and 1990. Tabulated information is presented for demand, price, and elasticity data; coal data; imports data; oil and gas data; refineries data; synthetics, shale, and solar/geothermal data; transportation data; and utilities data.

8661 (DOE/EIA/8560—3) **Regional demand forecasting model: 1977-1978 versions. Task 3, supplement to final documentation report.** Parhizgari, A.M. (Synergy, Inc., Washington, DC (USA)). 25 Sep 1978. Contract EM-77-C-01-8560. 87p. Dep. NTIS, PC A05/MF A01.

This appendix supplements Chapter II of the RDFOR Model documentation report. It consists of six tables: US total sector quantities, 1960-1975 in trillions of Btu; US fuel sector quantities, 1960-1975 in trillions of Btu; US fuel sector prices, 1960-1975 in constant 1975 dollars per million Btu; historical total sector quantities by region, 1960-1975 in trillions of Btu; historical energy prices by fuel/sector by region, 1960-1975 in constant 1975 dollars per million Btu; and historical energy quantities by fuel/sector by region, 1960-1975 in trillions of Btu.

8662 (EPA/600/9—78-022, pp 371-382) **Technology assessment of Western Energy Resource Development.** White, I.L. (Univ. of Oklahoma, Norman). Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

The consequences of Western Energy Resource Development and what can be done about them are determined. Specific objectives are to determine and analyze impacts, identify and define policy problems and issues, identify and describe development alternatives, evaluate and compare alternative policies and implementation strategies, and identify and describe research and data needs. The study includes the eight Northern Great Plains and Rocky Mountain States of: Arizona, New Mexico, Utah, Colorado, Wyoming, Montana, and North and South Dakota. The development of

coal, oil shale, uranium, oil, natural gas, and geothermal is assessed. The time period covered by the study is 1975 to the year 2000.

8663 (ORNL/TM—5890/S5) **Energy availabilities for state and local development: projected energy patterns for 1985 and 1990.** Vogt, D.P.; Rice, P.L.; Corey, T.A.; Pai, V.P. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 567p. Dep. NTIS, PC A24/MF A01.

This report (one of a series) presents projections of the energy supply, demand, and net imports of seven fuel types (gasoline, distillates, residual oil, crude, natural gas, coal, electricity) and four final consuming sectors. To facilitate detailed regional analysis these projections have been prepared for Bureau of Economic Analysis (BEA) areas, states, census regions, and the nation for 1985 and 1990. The data are formatted to present regional energy availability from primary extraction, as well as from energy-transformation processes. The tables depict energy balances between availability and use for each specific fuel. The objective of this series is to provide a consistent base of historic and projected energy information within a standard format. Such a framework should aid regional policy-makers in their consideration of regional growth issues that may be influenced by the regional energy system. However, for analysis of specific regions, this basic data should be supplemented by additional information which only the local policy analyst can bring to bear in his or her assessment of the energy conditions that characterize the region. Earlier volumes in this series have proved useful for both specific and general analysis of this type, and it is hoped that the current volume will prove equally so. This volume presents an updated benchmark projection series, which captures recent developments in the business as usual projections of energy supply and consumption due to national policy developments since the 1976 National Energy Outlook projection series were prepared.

8664 **Hydro-thermal power program.** Foleen, R. (Bonneville Power Administration, Portland, OR). pp 38-45 of Symposium on prequalification of thermal power plant sites in the Pacific Northwest. Vancouver, WA; Pacific Northwest River Basins Commission (1979).

From Thermal power conference; Seattle, WA, USA (15 Oct 1975).

The hydrothermal power program (HTPP) is a coordinated comprehensive plan developed by the Pacific Northwest's public and investor-owned utilities, BPA's direct-service industrial customers, and the Federal Government to develop generating and transmission capacity to meet the region's future power demands. Under the HTPP the federal government will continue to provide hydro peaking capacity and bulk transmission while the publicly owned and investor-owned utilities, electric utility cooperatives, and BPA industrial customers will cooperate to provide thermal generation. Power demands for the region are forecast. The capability of existing and planned hydro and thermal facilities for meeting these demands is discussed. The economic and environmental costs of the HTPP are considered. It is concluded that, although there are important savings in economic and environmental costs to be made by a highly integrated plan of development, the resulting interdependence means that the entire region will suffer if any participants fail to carry out the responsibilities which they have accepted under the plan. This same interdependence will be affected by any serious program delays, including those which might stem from disputes over the environmental aspects of new facilities or from budgetary limitations. Environmental concern should not take a back seat to power needs. What must be done is to eliminate environmental problems where possible or reduce them to acceptable levels. The entire region can enjoy the substantial benefits of an integrated power system if plans are carefully drawn with sensitivity to environmental and economic considerations, publicly examined, and implemented on schedule.

8665 **Planning for thermal power in Idaho.** Lanham, L. pp 46-50 of Symposium on prequalification of thermal power plant sites in the Pacific Northwest. Vancouver, WA; Pacific Northwest River Basins Commission (1979).

From Thermal power conference; Seattle, WA, USA (15 Oct 1975).

The role of the Idaho Power Co., which will construct the first major coal-fired power plant in southern Idaho, in planning for thermal power in Idaho is discussed by considering: state regulations on electric utilities and on the siting and operation of thermal power plants; future power demand; public opinion on and organized opposition to power plant construction; environmental effects analyses; and future Idaho Public Utilities Commission hearings on a proposed plant. (LCL)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 8010, 8011, 8091, 8629, 8630, 8632, 8658, 8665, 8698, 8699, 8707, 8714, 8786, 9339

8666 (ANL-PMS—79-2(Vol.6)) **World Energy Data System (WENDS). Volume VI. International agreement profiles.** (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 202p. Dep. NTIS, PC A10/MF A01.

The World Energy Data System contains organized data on those countries and international organizations that may have critical impact on world energy. The international agreement profiles in WENDS are all energy-related and are organized by energy technology. These are: coal; conservation; fusion; geothermal; nuclear fission; oil, gas, and shale; solar, wind, and ocean thermal; and other (cooperation in electrical power equipment acquisition, energy, energy research, etc.). The agreement profiles are accessible by energy technology and alphabetically by country.

8667 (DOE/GC—0002/1) **Powerplant and Industrial Fuel Use Act, PL 95-620: legislative history, 1978.** (Department of Energy, Washington, DC (USA)). Jun 1979. 819p. Dep. NTIS, PC A99/MF A01.

The text of Public Law 95-620, November 9, 1978 is presented. Briefly, the purposes of the Act are to reduce the importation of petroleum, to conserve natural gas and petroleum, to encourage and foster the greater use of coal and other alternate fuels, to encourage the use of synthetic gas derived from coal, to encourage the rehabilitation and upgrading of railroad service necessary to transport coal, to prohibit or minimize the use of natural gas and petroleum, to encourage modernization or replacement of existing and new electric power plants and major fuel-burning installations, to require that existing and new electric power plants or major fuel-burning installations which utilize fossil fuel comply with applicable environmental requirements, to insure that all Federal agencies utilize their authorities fully in furtherance of the purposes of this Act, to insure that adequate supplies of natural gas are available for essential agricultural uses, to reduce the vulnerability of the US to energy-supply interruptions, and to regulate interstate commerce. A report on the Committee of Conference submitted a report to accompany H.R. 5146 on some amendments recommended. A transcript of the conference meeting beginning on November 1, 1977 to November 9, 1977 is presented in Volume I.

8668 (DOE/GC—0002/2) **Powerplant and Industrial Fuel Use Act, PL 95-620: legislative history, 1978.** (Department of Energy, Washington, DC (USA)). Jun 1979. 666p. Dep. NTIS, PC A99/MF A01.

The transcript of the Joint Conference on Energy continues with Volume II presenting the November 9 to 11, 1977 hearings dealing with Public Law 95-620. A summary comparison of House and Senate differences for use in consideration of Provisions of H.R. 5146 relating to coal conversion is presented followed by some staff memoranda. A committee print, Comparative Print Prepared for the Use of the Committee on Energy and Natural Resources, United States Senate, on H.R. 5146 and H.R. 8444, is included.

8669 (DOE/GC—0002/3) **Powerplant and Industrial Fuel Use Act, PL 95-620: legislative history, 1978.** (Department of Energy, Washington, DC (USA)). Jun 1979. 820p. Dep. NTIS, PC A99/MF A01.

Debates on bills in the Senate dealing with PL 95-620 from March 10, 1977 to July 18, 1978 are presented. Then a report from the Senate Committee on Energy and Natural Resources dealing with the Natural Gas and Petroleum Conservation and Coal Utilization Act of 1977 is included. Transcripts of the markup of the Senate Committee on Energy and Natural Resources from July 13 to July 21, 1977 are recorded. The appendices to transcripts of the markup of the Senate Committee include staff memoranda, proposals, and recommendations dealing with coal conversion are also reported. (MCW)

8670 (DOE/GC—0002/4) **Powerplant and Industrial Fuel Use Act, PL 95-620: legislative history, 1978.** (Department of Energy, Washington, DC (USA)). Jun 1979. 638p. Dep. NTIS, PC A99/MF A01.

The Appendices to Transcripts of the Markup of the Senate Committee on Energy and Natural Resources (continued from Volume 3) first includes the text of S. 977, a Bill to require that new and, to the extent practicable, existing electric powerplants and major fuel-burning installations, in categories to be determined, utilize other than natural gas or petroleum as their primary energy source in compliance with applicable environmental requirements, and for other purposes. A paper, Air Pollution Impacts of the Oil and Gas Replacement Program in the Industrial and Utility Sectors, is presented. Then the hearings on S. 977, the Coal Utilization Act of 1977, S. 273, the Natural Gas and Petroleum Conservation and Coal Utilization Act of 1977, and S. 272, the Natural Gas Conservation Act of 1977 on March 21, 1977 and on March 29, 1977 are presented. Statements by witnesses and additional materials are included. (MCW)

8671 (DOE/GC—0002/5) **Powerplant and Industrial Fuel Use Act, PL 95-620: legislative history, 1978.** (Department of Energy,

Washington, DC (USA)). Jun 1979. 817p. Dep. NTIS, PC A99/MF A01.

Volume 5 continues material presented at the hearings on March 29, 1977 on S. 977, the Coal Utilization Act of 1977; S. 273, the Natural Gas and Petroleum Conservation and Coal Utilization Act of 1977; and S. 272, the Natural Gas Conservation Act of 1977. Many statements, reports from utilities, much compiled data, and exhibits are presented. The hearing on April 5, 1977 is recorded with many statements from witnesses presented and much additional information and exhibits included. (MCW)

8672 (DOE/GC—0002/6) **Powerplant and Industrial Fuel Use Act, PL 95-620: legislative history, 1978.** (Department of Energy, Washington, DC (USA)). Jun 1979. 549p. Dep. NTIS, PC A23/MF A01.

The hearings on S. 977, the Coal Utilization Act of 1977, of April 7, May 25, June 24, and June 30, 1977 are presented. Other than S. 977, bills considered are S. 272 and S. 273. It is recognized that coal conversion will have potentially significant adverse environmental impacts on air quality, water resources, and the land, which must be considered and voided. The first witness was Kentucky Governor Julian M. Carroll. Many witnesses followed Governor Carroll on April 7 and the following three hearings. Much additional material is presented. The text of S. 977 is included as Appendix VII, Draft Committee Print. The text of S. 1777 is also printed with changes indicated. It reads: to require that new and, to the extent practicable, existing electric powerplant boilers and major industrial boilers which utilize fossil fuels be capable of utilizing coal as their primary energy fuel in conformity with applicable environmental requirements, and for other purposes. (MCW)

8673 (DOE/GC—0002/7) **Powerplant and Industrial Fuel Use Act, PL 95-620: legislative history, 1978.** (Department of Energy, Washington, DC (USA)). Jun 1979. 536p. Dep. NTIS, PC A23/MF A01.

The Congressional Record of the House of Representatives concerning energy is presented for May 2, 1977 to October 14, 1978. Statements and debates are included. Reports are published on the National Energy Act (H.R. 8444) from the Ad Hoc Committee on Energy, followed by the Activity Report of the Ad Hoc Committee on Energy, April 21, 1977-January 2, 1979. A transcript of the Markup Session on H.R. 6831 - National Energy Legislation considering an amendment to H.R. 8444 is presented. (MCW)

8674 (DOE/GC—0002/8) **Powerplant and Industrial Fuel Use Act, PL 95-620: legislative history, 1978.** (Department of Energy, Washington, DC (USA)). Jun 1979. 770p. Dep. NTIS, PC A99/MF A01.

Briefings presented to the House Ad Hoc Committee on Energy are continued from Volume 7. Hearings conducted by the House Ad Hoc Committee on Energy on May 5, May 12, and July 19, 1977 are presented. The July 19, 1977 hearing is a Report of the House Committee on Interstate and Foreign Commerce, H.R. 6831. The text of H.R. 6831, a bill to establish a comprehensive national energy policy, is presented with corrections, deletions, etc. A Committee Print of June 19, 1977 is included showing Admendments to H.R. 6831. (MCW)

8675 (DOE/GC—0002/9) **Powerplant and Industrial Fuel Use Act, PL 95-620: legislative history, 1978.** (Department of Energy, Washington, DC (USA)). Jun 1979. 579p. Dep. NTIS, PC A25/MF A01.

The minutes of the markup of the House Committee on Interstate and Foreign Commerce dealing with H.R. 6831, a bill to establish a comprehensive energy policy, continue and are followed by appendices to the minutes. A hearing schedule and committee print of the House Subcommittee on Energy and Power and minutes of the markup of the House Subcommittee on Energy and Power and appendices to the minutes are given. The House Subcommittee on Energy and Power began a three-week session on the National Energy Act on May 9, 1977. Some hearings in the series are presented. (MCW)

8676 (DOE/GC—0002/10) **Powerplant and Industrial Fuel Use Act, PL 95-620: legislative history, 1978.** (Department of Energy, Washington, DC (USA)). Jun 1979. 804p. Dep. NTIS, PC A99/MF A01.

The Subcommittee on Energy and Power of the Committee on Interstate and Foreign Commerce, House of Representatives, began a three-week hearing on May 9, 1977 dealing with H.R. 6831, H.R. 687, H.R. 1562, H.R. 2088, H.R. 2818, H.R. 3317, H.R. 3664, H.R. 6660, and all similar and identical bills, bills to establish a comprehensive National Energy Policy. Many of the hearings are included in Volume 10 along with the statements by witnesses, exhibits, reports, and additional material. (MCW)

8677 (DOE/GC—0002/11) **Powerplant and Industrial Fuel Use Act, PL 95-620: legislative history, 1978.** (Department of Energy, Washington, DC (USA)). Jun 1979. 637p. Dep. NTIS, PC A99/MF A01.

Hearings continued on H.R. 6831, the President's proposed National Energy Act. Witnesses aired views on the impacts that industries would experience on converting boilers to coal. The final hearing of the three-week session was held on June 1, 1977. The June 1 session took a step back from the details of the many components of the President's plan and took a broad and longer term view of the plan as a whole. The hearings elicited substantial criticism of the many costs and burdens that would accompany the President's program. This is largely because the costs of conservation and conversion to coal precede the benefits by several years. A summary of the National Energy Plan is presented. (MCW)

8678 **Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4.** Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979). 150p. (CONF-790164—).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

This book is designed to provide accurate and authoritative information on the subject matter. It is sold with the understanding that the publisher is not engaged in rendering legal, accounting, or other services. A separate abstract was prepared for each of the 11 presentations at this seminar.

8679 **Washington perspective on energy: politics is the problem.** Cantus, H.H. (United Technologies, Washington, DC). pp 1-12 of Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4. Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

The nature, impact, and solution of the national energy problem involve factors far removed from its association with Btus. A complex mix of emotion, theory, personality, and career motivation combined with the very nature of the political issue provides the overlooked factor that the author terms the politics of energy. This paper brings that aspect into focus, hoping that recognition of that may show one way towards the ultimate solution of the problem. Neither the supply-only nor the demand-only aspects can remedy the problem. There must be additional forces at work or someone, somewhere would propose an orderly balance of the supply and demand points of view and the energy problem would be resolved. The political forces include activities relating to the making of governmental policy as well as the conduct of government and activities involved in the election and reelection of politicians. Factors which impact on the consciousness and the conscience of politicians in both elected and appointed positions are included. These may be the broad-based compendium of factors that may well be the major portion of the energy problem. Only a few of the types of problems facing government officials are discussed. (MCW)

8680 **Department of Energy.** Hill, R.F. (Engineering Societies Commission on Energy, Inc., Washington, DC). pp 13-22 of Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4. Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

Dr. Hill reviews briefly the genesis and functioning of the Department of Energy (DOE). DOE was created under Public Law 95-91 and came into being on October 1, 1977. The organizations that were absorbed are listed, and an organization chart is given. The programs of Resource Applications, Energy Technology, Office of Energy Research, Conservation and Solar Applications, Environment, and Defense were allocated 95% of the FY 1980 budget and responsible for R and D and DOE's energy resources management. Energy Information Administration, Policy and Evaluation, Federal Energy Regulatory Commission, Economic Regulatory Administration, Intergovernmental and Institutional Relations, and International Affairs Divisions are responsible for regulation, information, and policy. (MCW)

8681 **Public Utility Regulatory Policies Act of 1978: the Federal role.** Fleming, P.A. (Jones, Day, Reavis, and Pogue, Washington, DC). pp 23-28 of Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4. Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

The Public Utility Regulatory Policies Act of 1978, one of the acts of the National Energy Act, sets forth an agenda of regulatory standards which are not mandatory but must be considered by state regulatory authorities. State regulatory authorities and unregulated utilities are to measure the efficacy of the standards against three Federal purposes: conservation, efficiency, and equity. To sum the mandate of the Act, PURPA is calculated to provide for: continued basic authority and discretion for state regulators and nonregulated utilities;broadened participation in state regulation by Federal and

private parties; an adequate record for the state regulators and nonregulated utilities to determine the issues raised by the standards of the Act; and full, open consideration of the standards. The Act specifies three broad purposes that its specific standards are supposed to promote: conservation of energy supplies by electric utilities; optimization of the efficiency of use of facilities and resources by electric utilities; and equitable rates to electric consumers. (MCW)

8682 Coal utilization. Buck, L.E. (Patton, Boggs, and Blow, Washington, DC). pp 29-42 of Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4. Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

The Powerplant and Industrial Fuel Use Act of 1978, to strengthen the coal utilization policy of the US, is discussed in detail. When serious environmental concerns arose in the late 1960's, many power plants and industrial plants switched from burning coal to oil or natural gas in order to meet new and stringent air pollution requirements. When the Arab oil embargo of 1973 underscored the need to rely on fuels other than oil and gas, Congress saw the need to provide DOE authority to force certain plants to switch back to coal. The Energy Supply and Environmental Coordination Act of 1974 provided conversion authority as well as authority to order that future plants be constructed to burn coal. FUA has that same purpose - to reduce the use of oil and gas and to encourage the use of coal and other alternate fuels as primary energy sources for new and existing installations. The regulatory impact on industry will be much greater.

8683 Department of Energy price and allocation regulations. Buck, L.E. (Patton, Boggs, and Blow, Washington, DC). pp 43-71 of Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4. Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

The shortages and disruptions of petroleum and petroleum products experienced by the United States are summarized. Then the development of the scheme for the pricing and allocation of petroleum and its products is reviewed. The regulations administered by DOE have effects on users of energy as well as producers and sellers of crude oil and refined petroleum products. Some of the regulations are spelled out in the Emergency Petroleum Allocation Act of 1973; Federal Energy Administration Act; Energy Policy and Conservation Act; and Energy Conservation and Production Act; and the National Energy Act. How DOE controls prices on petroleum products is explained. DOE's price regulations control all four levels of the petroleum marketing chain: the producer, refiner, wholesaler, retailer.

8684 Coal: supply and demand. Holmes, C.D. (National Coal Association, Washington, DC). pp 72-77 of Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4. Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

The general outlook of coal supply and demand is discussed and the long-range effects of the Fuel Use Act for coal utilization are examined. It has taken five years to get some semblance of an energy policy developed since coal was declared king in 1974. Coal use and production have increased by over 100 million tons, but in terms of meeting our national energy needs, coal still supplies only about 20% of the total energy used in the US. The electric utility industry has increased its coal use by one-third since 1973 and accounts for almost all the increase in coal use since that date. Projections show utilities will have nearly doubled the coal use from the embargo year of 1973 by 1982. Most projections set utilities coal use for the target year of 1985 at about 700 to 800 million tons. Utilities last year used 481 million tons of coal and coal accounted for about one-half of all the electric energy consumed in the nation. Other consumers of coal either have not increased or have lowered their use of coal in the last five years. The prospects of meeting President Carter's goal of mining more than one billion tons of coal annually by 1985 and the impacts that labor, transportation, environmental, and other considerations hold in store for coal production and utilization over this period are examined. Based on data developed over the past year it can be reasonably predicted that we will mine and consume over 1 billion tons by 1985 and that coal use and the capability of the industry to mine that coal will continue to show a healthy increase after that magical year. (MCW)

8685 Natural Gas Policy Act of 1978: impact on users. Grenier, E.J. Jr. (Sutherland, Asbill, and Brennan, Washington, DC). pp 78-109 of Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4. Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

The Natural Gas Policy Act of 1978, P.L. 95-621, may have sweeping impacts upon the price and availability of natural gas to industrial consumers. After discussing all the parts of the Act, it is concluded that the ultimate impacts of the Natural Gas Policy Act and related legislation appear to be adverse to industrial non-agricultural users of natural gas. Industrial users are likely to find their gas more costly - in many cases incrementally priced - and they are likely to be curtailed sooner than before the legislation was passed. The abolition of the interstate/intrastate market distinction may, in addition, significantly impede the ability of industries to obtain gas through self-help remedies, although it is hoped that it will increase the general gas supplies available to the interstate market. Finally, what self-help gas that industrials do obtain under Order 533-type programs may be allocated away from them in the event of a severe supply emergency, although this allocation authority is limited. (MCW)

8686 Energy conservation. Castellani, J.J. (National Association of Manufacturers, Washington, DC). pp 110-117 of Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4. Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

Events leading to the passage of the National Energy Conservation Policy Act of 1978 are reviewed. The actual legislation that the President submitted only included parts of the whole conservation program. The Senate added two important points. From a utility perspective and from an automobile perspective, there was some alarm with what the President was proposing. Two amendments were added, the Kennedy Amendment and the Metzenbaum Amendment. The Kennedy Amendment mandated individual corporate reporting on the heating efficiencies of furnaces and boilers. The Metzenbaum Amendment would have required that the Secretary of Energy establish efficiency standards for certain categories of industrial equipment, primarily electric motors and pumps. Some revisions were made with the Senate passing a version on October 9, 1978 and the House passing it as part of a package of a National Energy Conservation Policy Act. The provisions of the Act are reviewed. (MCW)

8687 Solar energy and the National Energy Act. Sullivan, T.F.P. (Government Institutes, Washington, DC). pp 118-125 of Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4. Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

To better understand the thrust of the National Energy Act mandates for solar energy, the following discussions are presented: solar energy and the common law, solar law and easements, states and solar law, local efforts - new San Diego ordinance. Then, the provisions in the National Energy Act dealing with solar energy are investigated. The National Energy Conservation Policy Act of 1978 and the Energy Tax Act of 1978 contain provisions for solar energy, and these are reviewed briefly. (MCW)

8688 Tax legislation affecting energy. Hanes, D.G. (Colby, Miller and Hanes, Washington, DC). pp 126-137 of Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4. Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

New tax revisions that relate to energy were passed in two separate bills: the Revenue Act and the Energy Tax Act. Both will be reflected in revised editions of the Internal Revenue Code. After reviewing the investment tax credits of these two Acts, miscellaneous provisions are discussed. These are covered in subjects entitled: geothermal and geopressurized gas and transportation tax provisions. Residential energy tax credits are discussed in the following: insulation and energy-conserving components and renewable energy source property. (MCW)

8689 Rule is: energy tomorrow, and energy yesterday - but never energy today. Perreault, E.A. (Air Products and Chemicals, Allentown, PA). pp 138-142 of Energy users, 1979: a comprehensive analysis of the National Energy Act. Volume 4. Sullivan, T.F.P. (ed.). Washington, DC; Government Institutes, Inc. (1979).

From Energy users law seminar; Washington, DC, USA (11 Jan 1979).

The author focuses on the Public Utilities Regulatory Policy Act of 1978; the Act requires that all state regulatory authorities and nonregulated utilities consider issues of ratemaking standards. The basic current thrust behind the Act, and the stated objective of its authors, is to promote three issues: conservation of energy, efficient use of facilities and resources, and equitable rates to consumers. As

required by the Act, the regulators must commence, or announce dates for hearings on the follwoing issues within the next two years: cost-of-service, time-of-day rates, load management techniques, seasonal rates, declining block rates, and interruptible rates. The Act further requires that consideration of these standards shall be completed and a determination of their applicability made within the next three years. Additionally, the new law requires the regulatory agency to have considered within two years the following items: master metering, automatic adjustment clauses, termination of service, and advertising. The author notes that perhaps the most vital concern to industrial users is the topic of lifeline rates. Under the Act, the DOE must prescribe the voluntary guidelines to be established for considering the standards and develop rules for the gathering of all information deemed relevant in the consideration of these standards. (MCW)

8690 Current federal activity related to prequalification of thermal power plant sites. Robart, A.W. (Nuclear Regulatory Commission, Washington, DC). pp 1-4 of Symposium on prequalification of thermal power plant sites in the Pacific Northwest. Vancouver, WA; Pacific Northwest River Basins Commission (1979).

From Thermal power conference; Seattle, WA, USA (15 Oct 1975).

The status and direction of federal legislation to facilitate thermal power plant siting, emphasizing nuclear power plant siting and some activities of the Nuclear Regulatory Commission related to power reactor siting are briefly reviewed. (LCL)

8691 Prequalification of thermal power plant sites in Oregon. Woods, W.K. (Department of Energy, Salem, Oregon). pp 5-11 of Symposium on prequalification of thermal power plant sites in the Pacific Northwest. Vancouver, WA; Pacific Northwest River Basins Commission (1979).

From Thermal power conference; Seattle, WA, USA (15 Oct 1975).

Procedures used in Oregon in the issuing of site certificates for nuclear or fossil-fueled power plants are described, and are illustrated by tracing the activities associated with the Portland General Electric Co's 1972 application for site certification for a combination of nuclear and coal-fired power plants in Morrow County. (LCL)

8692 Thermal power plant site prequalification: a Washington State perspective. Lightfoot, J.F. pp 12-15 of Symposium on prequalification of thermal power plant sites in the Pacific Northwest. Vancouver, WA; Pacific Northwest River Basins Commission (1979).

From Thermal power conference; Seattle, WA, USA (15 Oct 1975).

Experience in the State of Washington in establishing regulations on and conducting reviews of siting qualifications for nuclear and fossil-fuel power plants is discussed. It is contended that detailed consideration of all the physical attributes of a site should be done only after a determination has been made of public need for and acceptance of a given site. (LCL)

8693 Citizen role in thermal power plant siting. Leed, R.M. pp 16-25 of Symposium on prequalification of thermal power plant sites in the Pacific Northwest. Vancouver, WA; Pacific Northwest River Basins Commission (1979).

From Thermal power conference; Seattle, WA, USA (15 Oct 1975).

Working from the thesis that the best way to ensure broad public acceptance of power plant siting decisions is to permit citizens to participate in the siting procedure, the role of citizen intervenors and the obstacles they face are discussed. (LCL)

8694 Why the need for pre-designated sites. Stiles, J.T. (Pacific Power & Light Co., Portland, OR). pp 26-36 of Symposium on prequalification of thermal power plant sites in the Pacific Northwest. Vancouver, WA; Pacific Northwest River Basins Commission (1979).

From Thermal power conference; Seattle, WA, USA (15 Oct 1975).

Forecasting load growth that might occur in the Pacific Northwest Region and the role of these forecasts in utility power planning and power plant siting are discussed. (LCL)

8695 Public utility program to identify future thermal generation sites in the Pacific Northwest. Tillson, D.D. pp 51-69 of Symposium on prequalification of thermal power plant sites in the Pacific Northwest. Vancouver, WA; Pacific Northwest River Basins Commission (1979).

From Thermal power conference; Seattle, WA, USA (15 Oct 1975).

Almost all proposed strategies for meeting projected energy demands of the next two decades include building a substantial number of powerplant facilities. This paper summarizes the investigative approach and findings of a study whose primary objective was to identify and recommend future potential sites suitable for thermal (nuclear or fossil fuel) electric power generating stations in the Pacific Northwest. Secondary objectives were to expand the siting methodology to include adaptive features, to develop effective documentation procedures, to establish a data management system, and to provide basic data which may be supplemented and refined as needed to meet future siting requirements.

8696 Prequalification of thermal power plant sites. Woodley, N.H. (Portland General Electric Co., OR). pp 70-78 of Symposium on prequalification of thermal power plant sites in the Pacific Northwest. Vancouver, WA; Pacific Northwest River Basins Commission (1979).

From Thermal power conference; Seattle, WA, USA (15 Oct 1975).

The experience of the Portland General Electric Co. and the State of Oregon in establishing the first prequalified thermal power plant site in the state is reviewed with information included on federal and state legislation on site prequalification, the advantages to utilities and to the government of prequalification, and prequalification problem. The Portland General Electric experience in the process of prequalification of the Boardman thermal powerplant site stresses the need for considerable effort in the formulation and promulgation of flexible and efficient prequalification regulations. The electric utility industry needs carefully structured design criteria which can form the basis for demonstration of acceptability of specific sites to meet agreed upon allowable impacts. The commitment to prequalification of powerplant sites takes the form of a legal contract between the utility and government. The utilities will live up to their prequalification commitments, and government agencies must recognize this utility commitment and responsibly discharge the government commitment to control land, water, and air uses outside of the site area to ensure that the utility interest is protected. Anything less than a total commitment will hopelessly bog down the prequalification concept and leave the country in a worse predicament than we have seen in the past three years due to the added siting delays. (LCL)

8697 California Energy Commission Utility Financial Study, Touche Ross and Co. Sacramento, CA; California Energy Commission (1978). 133p. (NP—24058).

The focus of this study is on understanding and defining the role of the California Energy Resources Conservation and Development Commission (CERCDC) financial staff and on developing operating polices relative to the planning and regulatory process of an electric utility. The work performed during the study can be classified into the following areas: development of analytical methodology to be used in analyzing financial feasibility of utility resource plans; review of the CERCDC staff analysis of the San Diego Gas and Electric resource plan submitted in connection with the Sundesert NOI; analysis of the San Diego Gas and Electric resource plan submitted on 12/22/77 as part of CERCDC Common Forecasting Methodology II; training of financial staff in application and use of the analytical methodology and in regulatory theory and practice; analysis and research of other financial issues and related staff training; and evaluation and analysis of CERCDC financial models. The report summarizes the results of the study and recommendtions with regard to Commission policies, the regulatory process, and the role of financial staff in supply planning and policy development are presented.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 8667, 8668, 8669, 8670, 8671, 8672, 8673, 8674, 8675, 8676, 8677, 8781, 9339

8698 Acceptable ways to hasten the substitution of coal for oil. Washington, DC; President's Commission on Coal (1979). 23p. (NP—24204).

The President's Commission on Coal held two days of hearings and undertook a study of the means, costs, and benefits of stemming oil imports through increased coal use. The Commission says that current policies, at best, will only slow the growth in oil imports so that by 1990 they will be at 9 million barrels per day. The Commission recommends a program of actions involving both the direct use of coal and the creation of a synthetic fuels industry to decrease oil imports 1.3 million barrels per day or 16% by 1985 and 4.5 million barrels per day or 50% by 1990. (MCW)

COAL

REFER ALSO TO CITATION(S) 8000, 8006, 8010, 8011, 8012, 8025, 8046, 8050, 8062, 8631, 8654, 8682, 8684

8699 (CONF-790202—, pp 39-45) **Environmental considerations in the mining and use of coal.** Williams, J. Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Activities of the Office of Surface Mining (OSM) in implementing the Surface Mining Control and Reclamation Act of 1977 are described. OSM will evaluate state programs and will administer directly to any state failing to submit an acceptable program. The author reviews the federal environmental performance standards, stressing the implications of the requirement that land must be returned to its approximate original contour and that high walls be eliminated in mountain areas. Mountain top removal will be permitted if erosion and landslides are prevented. Other regulated areas require miners to segregate soil for revegetation during mining, make preblasting announcements and offer damage surveys, protect surface and ground waters, and meet specific standards for prime farmland. OSM is granted specific enforcement tools, such as mine inspections, the power to issue notices of violation or orders of cessation, administrative fines (which are open to appeal), court injunctions, and criminal penalties. OSM has not yet determined the impact of these regulations on the cost of coal or how to deal with small operators who have avoided compliance.

8700 (CONF-790202—, pp 47-54) **National coal outlook.** Price, R. Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

The US consumed 660 million tons of coal in 1978, a two percent drop from 1977 due to declining steel production, and produced five percent less because of the long labor strike. Forecasters predicted a good year for 1979, but certain market and production dislocations (such as labor and transportation problems, a decline in world demand for domestic metallurgical coal, and the impacts of government policies and actions) could change the situation. The intent of recent government regulations were felt to be confusing in respect to the use of coal and natural gas, production capabilities, land use, and environmental constraints which conflict with the concept of increasing coal use. By increasing the costs of coal mining, transport, and combustion, these regulations are economic disincentives. A mechanism for evaluating and balancing national goals is needed to resolve the present uncertainties.

8701 (CONF-790202—, pp 55-63) **Perspective of the small coal producer.** Hearn, H.E. (Facts About Coal in Tennessee, Knoxville). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Coal, argued to be the only viable energy source available to meet short-term energy needs, is currently produced in an atmosphere of public misunderstanding, excessive regulation, inflation, and slow demand growth, according to Mr. Hearn. Small coal operations are finding it increasingly difficult to meet capital and marketing requirements. Mr. Hearn notes that the Surface Mining Control and Reclamation Act specifies 100,000 tons of coal per year of production as the cutoff for qualification for the small operator assistance program; TVA, however has offered to extend assistance to those producing less than 250,000 tons/year, a figure he feels to be far more reasonable. Delays in administering permits and the engineering requirements for satisfying new permit procedures and complying with environmental regulations are too expensive and require more business and marketing expertise than most small operators have. Examples are drawn from the East Tennessee area, where small opertions are important, to illustrate these points and to examine their implications. The public is asked to consider whether the economic and social impacts that will accompany the loss of small coal operations justify the benefits of these regulations.

PETROLEUM

REFER ALSO TO CITATION(S) 8000, 8063, 8090, 8091, 8092, 8630, 8683, 8782

8702 (DOE/EIA—0194/3) **Midterm oil and gas supply model: system guide. Model documentation report MDR/ES/79-01.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Nov 1979. Contract EI-78-C-01-6398. 58p. Dep. NTIS, PC A04/MF A01.

This document describes the computer implementation of the Mid-Term Oil and Gas Supply Model for use in installing the model on a user's computer. All appropriate Job Control Language (JCL) and operating procedures information is included for installing, testing, and utilizing the models on IBM 360 or 370 computers. To introduce the user to the model's operational functions, a section describing the overall flow of model processing is included.

NATURAL GAS

REFER ALSO TO CITATION(S) 8000, 8063, 8092, 8099, 8107, 8685, 8702

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 8654

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 8201, 8216, 8225, 8630, 8639

8703 (CONF-790202—, pp 85-89) **Alterative fuels.** Sklar, S. (National Center for Appropriate Tech., Washington, DC). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

The status of alternative liquid fuels is described as one in which promoters have been unconvincing and legislators slow to respond, while some individuals have successfully focused on economically viable, technically feasible solutions for short-term use. Examples include an automobile designed to perform well on methanol, an automotive fuel made from distilled afta-toxin-contaminated grains, and an on-site, solar-assisted still for agricultural wastes. Problems of supply, process, and economics differ for small- and large-scale facilities, although successful operations can be cited for a range of facility sizes. An unmotivated public and the lack of either a consensus in the private sector or an effective energy policy have resulted in general inaction. A long-term approach during which innovative ideas can be tried and demonstrated will help to develop a national consensus. Direct input by individuals and communities into legislative deliberations will contribute to this process.

8704 **Fact and fiction about alternative fuels.** Gregory, D.P. Chicago, IL; Institute of Gas Technology (1979). 11p. (CONF-791009—10).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Dr. Derek Gregory discusses problems that occur in communications between the technical community and the general public in matters concerning energy. Examples from his experience in hydrogen, alcohol, and substitute natural gas technology are used. Some of the energy facts that he feels must be communicated to the general public are given.

ELECTRIC POWER

REFER ALSO TO CITATION(S) 8309, 8432, 8433, 8445, 8655, 8669, 8681, 8689, 8697

8705 (CONF-790202—, pp 141-148) **Regional energy futures: a utility view.** Voyles, D.E. (Duke Power Co., Charlotte, NC). Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Mr. Voyles describes the Southeast's energy-supply prospects and the trend for utilities to focus on conservation and peak-shaving strategies because of the high costs of new generating units. The regulatory process and public approval are also costly factors that increase the rate of inflation. While there is need for the public to know what electric utilities are doing, Mr. Voyles says there is often uncertainty about who it is that really speaks for the public and about the extent that the public really wishes to participate. He notes that if the utilities, the regulators, and the public can somehow find better ways of working together to avoid expenditures, the payoff can be lower energy costs for all of us. The three Southeast conference speakers respond to questions on national leadership, ways to reduce consumption, energy regulation, TVA's position as a benevolent dictator, and TVA's potential as a national power supplier.

8706 (CONF-790202—, pp 261-267) **Changing roles of utilities.** Ring, L. Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Dr. Ring says that those participating in energy production must develop the technology needed to deliver adequate supplies without damaging the environment or destroying the quality of life. He feels that the Tennessee Valley Authority (TVA) has a special role in showing other utilities how to cope with the changes they face. TVA's demonstration programs will introduce new technologies and energy applications, new rate structure designs, and new techniques in power delivery and load management. TVA is improving its communication technique so that consumers' concerns will be heard and the utility's intents can be understood. A synopsis of the important points raised during the WATTec conference summarizes the energy path options and the basic principles to follow in making energy choices.

8707 (EMD—79-73) **Electrical energy development in the Pacific Southwest.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 16 Oct 1979. 218p. General Accounting Office, Washington, DC.

Report to the Congress of the United States by the Comptroller General.

GAO analyzed the Pacific Southwest to see how the Western Area Power Administration, the only Federal power agency in the area, could implement the National Energy Principles of electricity conservation and development of renewable resources, such as solar and wind power. GAO concluded the Power Administration should act as a lead agency for implementing conservation practices and for commercializing solar and wind technology in its marketing area. This would result in lower overall electricity costs to consumers in the Pacific Southwest.

8708 (EPRI-SR—1201-SR) **Technical Assessment Guide.** (Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1979. 169p. Dep. NTIS, PC A08/MF A01.

The guide, prepared by EPRI personnel, was compiled for the use of EPRI staff and its contractors to provide a common basis for evaluation of alternatives. Both data and methods are presented. The sections on data contain fuel-price projections, transmission-system costs, and information regarding cost and performance of generating plants using a broad range of present and future technologies. The methods sections deal with basic financial assumptions and describe the techniques commonly used by utilities in assessing the relative economic worth of alternative technologies, plants, or system configurations.

8709 **New power picture.** *Indian East. Eng.;* **120**: No. 2, 59-60(Feb 1978).

The Indian government's strategy of power development includes electricity production basing on an optimum mix of hydropower, coal, and nuclear energy. While the coal-based thermal stations would continue to be the most important source of electricity production in the foreseeable future, all efforts will have to be made towards rapid exploitation of hydro resources. The government strategy also includes avoiding use of oil and gas for power generation, as far as possible.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 8000, 8227, 8230, 8231, 8441, 8444, 8446, 8664, 8665, 8667, 8668, 8670, 8671, 8672, 8673, 8674, 8675, 8676, 8677, 8690, 8691, 8692, 8693, 8694, 8695, 8696, 9061, 9064, 9239

8710 (CONF-790202—, pp 21-37) **Current and prospective technologies for electric power production.** Falkenberry, H.L. Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

Mr. Falkenberry feels the trend toward more oil burning to generate electricity, in response to the environmental problems of coal, must be reversed although it will be very difficult. The Tennessee Valley Authority (TVA) expects the annual power demand growth to be about 4% for the Tennessee Valley to the year 2000, compared to about 5.6% for the US as a whole. While it is evident that petroleum substitutes must be found, it is also clear that this will require substantial amounts of time and money. The extent to which electric power and energy have price and demand elasticity also remains unclear. If the projections above are true, the electric power industry must increase its generation capacity three and one half times to meet demand. Since power plants must now meet environmental standards, TVA plants are combining chemical scrubbers with electrostatic pumps and relying on existing technology to place equipment orders for plants under construction. TVA is also continuing its research efforts on sulfur-removal technology, fluidized-bed combustion, combined-cycle gas turbine-steam turbine power plants, fuel cells, and magnetohydrodynamics; these activities are described briefly.

8711 (DOE/ERA—0007/2) **Interim report on the performance of 400-megawatt and larger nuclear and coal-fired generating units: performance through 1976.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Nov 1979. 117p. Dep. NTIS, PC A06/MF A01.

This report is an update of DOE/ERA-0007, Interim Report on the Performance of 400 Megawatt and Larger Nuclear and Coal-Fired Generating Units - Performance Through 1975. The most recent EEI data for nuclear units and for coal units less than 600 MW(e) and having at least one full year of commercial operation are included in this analysis. The analyses cover the following: coal and nuclear units, 400-MW nameplate and larger; historical data through 1976; four industry-recognized performance indices (capacity factor, availability factor, equivalent availability, and forced outage rate); four types of geographical analysis (national, individual, individual utilities, and individual utilities by states); and rankings of states and utilities by performance indices. (MCW)

8712 (DOE/FERC—0036) **Steam-electric plant air and water quality control data. Summary report for the year ended December 31, 1976, based on FPC Form No. 67.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Oct 1979. 233p. Dep. NTIS, PC A11/MF A01.

This eighth summary report contains information collected on an annual basis that relates to the nationwide impact of steam-electric power plants on the environment. Summarized in tables are: (1) Air Quality Data Aggregated by State and Geographic Region and by Air Quality Control Region, and (2) Water Quality Data Aggregated by State and Geographic Region and by Water Resource Region. (MCW)

8713 (DSD—122) **Appendices to DSD No. 90, the regional employment and income effects of a 50-MW wood-fired power plant.** VanderWerf, P. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). Aug 1978. 40p. Resource Policy Center, Hanover, NH.

A program, named I-O and written in BASIC, is printed in this document and the data file, I-ODATA, is produced in a line-numbered version following the I-O program. The methods used to calculate the input-output estimates of income and employment effects of the 50-MW wood-fired power plant are conveyed by describing the 11 tasks performed by the program.

8714 **Symposium on prequalification of thermal power plant sites in the Pacific Northwest.** Vancouver, WA; Pacific Northwest River Basins Commission (1979). 86p. (CONF-7510201—).

From Thermal power conference; Seattle, WA, USA (15 Oct 1975).

Nine papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 8634

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 8638, 8652, 8780, 8787, 8811

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 8229, 8640, 8707

8715 (DSD—94) **Fallacies that block the search for an alternative energy plan.** Meadows, D. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). Dec 1977. 10p. Resource Policy Center, Hanover, NH.

Mr. Meadows says there are numerous pressures that hinder the development and spread of small-scale, appropriate energy technologies. He comments on five specifically, denoting them as fallacies, namely: (1) the US must sustain historical growth rates in energy consumption to maintain its economic growth and its current standard of living; (2) for maximum efficiency, the US should try to develop one homogeneous form to provide for the bulk of its increased energy demand; (3) when electricity is required, economies of scale overwhelmingly favor large, centralized production facilities; (4) the economic competitiveness of alternative technologies should be based on comparison with energy systems currently utilizing inexpensive fossil fuels; and (5) the widespread adoption of small-scale technologies cannot occur without substantial technological advance and extensive government subsidies. Many other misconceptions are briefly cited.

8716 (SERI/TR—51-195) **Renewable energy sources for the world's poor: a review of current international development assistance programs.** Ashworth, J.H. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1979. Contract EG-77-C-01-4042. 81p. Dep. NTIS, PC A05/MF A01.

Foreign assistance funding of the creation, testing, and use of renewable energy sources concerning worldwide efforts to provide energy for Third World development is examined. Donor agencies and developing nations give serious attention to technologies that have been considered exotic and marginal: small-scale hydroelectric generation, solar water heating and distillation, biomass conversion to methane gas and alcohol, wind power, photovoltaic-powered small-scale irrigation, and village-level solar-powered absorption refrigeration. An initial effort to assist in the international coordination of donor activity and in the sharing of information generated by foreign-assistance projects that use renewable energy sources is

reported. The report mainly provides information about specific development projects. It contains only a few of the projects that have been approved and funded by 1 June 1979. (MCW)

SOLAR

REFER ALSO TO CITATION(S) 8233, 8238, 8239, 8240, 8242, 8243, 8276, 8289, 8309, 8317, 8687

8717 (CONF-790202—, pp 97-105) **Energy alternatives in the Tennessee Valley Region.** Hemphill, R. Jul 1979.

From 6. annual energy conference and exibition energy and the public; Knoxville, TN, USA (21 Feb 1979).

The Tennessee Valley Authority (TVA) has adopted the position that it is time to stop studying solar and other energy alternatives and to see that commercialization happens. TVA's demonstration efforts include a solar water heater program, solar audits and installation inspections, an energy-efficient office building, biomass, assistance to a passive-solar heated retirement village, and wood-burning heater programs. Although modest in scope, these projects make TVA the nation's leader in solar programs sponsored by utilities. Further marketing and promotion of specific energy sources and applications will be affected by the outcome of these demonstrations. TVA sees the community development opportunities of solar energy, as well as community acceptance, and economics. Free of institutional barriers in respect to rate-of-return requirements, TVA has more opportunity than investor-owned utilities to explore a range of potential technologies.

8718 **Role of the government in subsidizing solar energy.** Yokell, M.D. (Solar Energy Research Inst., Golden, CO). *Am. Econ. Rev.;* **69**: No. 2, 357-361(May 1979).

Government subsidies for solar energy are examined in terms of the rationale for a Federal subsidy program, the type of program required, and the methods used to determine the funding level of each program. Justification for solar energy funding is based on the benefits to social welfare for both first best and second best reasons, which are described. Five policy instruments for optimal and socially acceptable subsidies are needed to solve all the problems outlined in the first- and second-best problems in order to analyze the associated economic problems, define the objectives, choose the proper instruments to meet those objectives, choose specific programs that are within the framework of those instruments, and optimize funding levels. 12 references.

8719 **Can solar energy contribute significantly to the solution of the world's energy famine.** Backus, C.E. (Ariz State Univ, Coll of Eng and Appl Sci, Tempe). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1406-1411(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

There is a wide diversion of projections as to what the impact of solar energy will be in the long term. These projections vary between a contribution of 1-30% of the energy demands in the industrialized world. The developing nations are presently very dependent upon solar energy in the form of wood and plant and animal waste. Their dependence in the future may become even greater. Solar energy cannot be the solution to the world's energy problem, but this is also true for the other energy sources.

OTHER

REFER ALSO TO CITATION(S) 8222, 8224, 8317, 8400, 8402, 8403, 8404, 8405, 8406, 8407, 8408, 8409, 8410, 8412, 8413, 8414, 8415, 8424, 8425, 8441, 8444, 8717

8720 (BNL—26851) **Methodology for regional economic analysis of urban refuse as an energy source for the Northeast.** Meier, P.M.; Le, T. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 34p. (CONF-7906143—1). Dep. NTIS, PC A03/MF A01.

From Annual Northeast Regional Science Association meeting; Amherst, MA, USA (Jun 1979).

The potential contribution of municipal refuse as an energy source depends on the spatial distribution and characteristics of population and the cost of alternative fuels. A methodology for regional economic analysis of urban refuse as an energy source requires a methodology that integrates population, interregional fuel price variations, and other engineering variables into a single model that can be subjected to sensitivity analysis helpful to the policy maker. Such a framework in the context of the Northeast States is developed. The area includes New England, New York, New Jersey, Pennsylvania, Maryland, Delaware, and the District of Columbia.

8721 (DOE/ET—0114/1, pp 105p, Paper 1) **Availability of agricultural processing wastes for utilization as a feedstock for the production alcoholic fuels.** Guymont, F.J.; Alpert, J.E. Sep 1979.

Includes Appendix A.

In Report of the alcohol fuels policy reivew. Raw material availability reports.

This study was undertaken to provide basic information to the Alcohol Fuels Subcommittee on the availability of food processing wastes as a feedstock for conversion to alcohol fuels. In this study, every attempt was made to obtain the latest available information on the amounts and types of wastes available. Whereever possible, several alternative sources were checked to verify the estimates obtained. In the course of the study, numerous food processors, associations, and individuals were contacted in addition to a thorough literature review. This study suffers from the same difficulties as do other broad general studies of this nature. By necessity generalities must be made which are not necessarily valid on the local level. While on the average the results are valid, the sum does not necessarily follow from the parts. For this reason, it is important that follow-up site specific studies be made to determine the mechanisms by which alcohol production from food processing wastes can be achieved.

8722 (DOE/ET—0114/1, pp 34p, Paper 2) **Availability and cost of grain for use as alcohol fuels feedstocks. Final report, November 28, 1978.** Sep 1979.

In Report of the alcohol fuels policy reivew. Raw material availability reports.

The primary objective of this research effort was to obtain an estimate of the amount of corn, wheat, and grain sorghum which would be available for ethanol production to the year 2000. Severe limitations on time and funds prevented an in depth study of grain availability and the implication of using grain for fuel. Given this framework two techniques were developed to project grain availability. The first technique to determine the amount of grain which could be produced on the current total cropland base assumed a USDA policy which does not involve production restrictions. For a bases of comparison straight line projections were made for the three grains. This second set of projections were based strictly on historical production trends.

8723 (DOE/ET—0114/1, pp 88p, Paper 3) **Availability of sugar crops for production of alcohol fuels. Final report.** Riddle, W.E.; McClure, T.A.; Lipinsky, E.S. (Battelle Columbus Division, OH). Sep 1979.

Includes Appendixes A, B, and C.

In Report of the alcohol fuels policy review. Raw material availability reports.

This report estimates the costs and quantities of fermentable sugars produced from sugarcane, sugar beets and sweet sorghum for ethanol production. For policy purposes four scenarios were developed describing possible conditions for sugar crop production. The first scenarios were developed describing possible conditions for sugar crop production. The first scenario - Optimistic Sugarcane and Sweet Sorghum Production - resulted in the potential production of more than 10 billion gallons of ethanol by 2000 at a cost of $0.97 for the fermentable sugars in a gallon of ethanol. The second scenario - Pessimistic Sugarcane and Sweet Sorghum Production - resulted in the potential production of slightly less than 5 billion gallons of ethanol by 2000 at a cost of $1.58 for the fermentable sugars in each gallon of ethanol. The remaining scenarios were between the two extremes. The Southeast, Delta States and Southern Plains accounted for nearly 60 percent of the fermentable sugar production, while the Corn Belt, Lake States and Northern Plains accounted for nearly one-third of the fermentable sugar production. The production of fermentable sugars produced in the southern tier of the US did not change appreciably among the four scenarios. Sugarcane and sweet sorghum would be produced in the southern states while sweet sorghum would be produced only in the northern states. The cost estimates do not consider additional revenue from the sale of possible by-products derived from the production of sugar crops. Considering only the energy expended in agricultural production, grain crops have a net energy balance of 0.42 to 0.45 quads from 1980 to 2000. Sugar crops show a net energy balance of 0.05 quads in 1983, 0.37 quads in 1990, and 0.89 quads in the year 2000. Deduction of energy required for processing and conversion of each crop into alcohol will, of course, lower these estimates.

8724 (DOE/ET—0114/1, pp 88p, Paper 4) **Potential availability of wood as a feedstock for methanol production.** Salo, D.J.; Henry, J.F. (MITRE Corp., McLean, VI). Sep 1979.

In Report of the alcohol fuels policy review. Raw material availability reports.

In support of the Alcohol Fuels Policy Review Group/DOE, MITRE/Metrek has estimated the availability of wood as a source of feedstock for methanol production during the 1975 to 2000 period. Enough wood is potentially available to support a national program which requires the equivalent of a 10 percent alcohol in gasoline blend. The long term projected cost of feedstock is estimated to be 21 to 27 c/gallon. In the long term, Silviculture Energy Farms will have a favorable impact on the cost and availability of feedstock.

8725 (DOE/ET—0114/1, pp 21p, Paper 5) **Cropland reserve for fuel production.** Dovring, F. Sep 1979.

In Report of the alcohol fuels policy review. Raw material availability reports.

Fuel from field crops is a short-term prospect of limited significance for the country's energy problem but of larger potential significance for farm support policy if costs are found acceptable. In the spring of 1978, 24 million acres were signed up for set-aside. Potential grain production from this acreage is estimated at 21.8 million metric tons (857 million bushels) of corn and 13.9 million metric tons of other grains. Cost of production per bushel of corn (56 pounds) in 1978 is estimated at $2.60, of which $1.65 non-land costs and $1.40 costs other than land, labor and taxes. The latter figure represents real cost to the national economy. For other grains, the same costs are $2.75 to $2.00, $2.00 to $2.10, and $1,60 to $1.65, respectively. Whole plants and root crops raise unsolved technical problems which leave open whether these could be viable alternatives to grain. Long-term outlook is uncertain. Substitution of vegetable foods for meat could eventually set free 100 million tons of grain (early next century). For long-term fuel supply, forest production holds more promise than field crops.

8726 (DOE/R5/10126—1) **Combine wood/fuel technologies with a group-oriented timber stand improvement program: model for waste wood utilization and resource renewal. First quarterly report.** Dulaney, S. (Long Island Oyster Farms, Inc., Northport, NY (USA)). 1979. Contract FG02-79R510126. 7p. Dep. NTIS, PC A02/MF A01.

The duties of the County Forester in Michigan are outlined. Stress is placed on the management of wood lots and public assistance programs. Goals for legislation are discussed. Market data for firewood is presented and several news articles are included.

ENERGY CONVERSION

REFER ALSO TO CITATION(S) 8727

8727 **Energy conversion engineering conference. Vol. 3.** Warrendale, PA; Society of Automotive Engineers (1978). 393p. (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Separate abstracts were prepared for the individual papers included. (WHK)

8728 **Energy conversion engineering conference. Vol. 1.** Warrendale, PA; Society of Automotive Engineers, Inc. (1977). 908p. (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Separate abstracts were prepared for the individual papers included. (WHK)

MHD GENERATORS

REFER ALSO TO CITATION(S) 8435

DESIGN AND DEVELOPMENT

8729 (FE—2215-11) **Critical contributions in MHD power generation. Quarterly technical progress report, March 1-May 31, 1978.** Louis, J.F. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jun 1978. Contract EX-76-C-01-2215. 285p. Dep. NTIS, PC A13/MF A01.

Research and development in open-cycle coal-fired MHD power generation at MIT is described in detail. Separate abstracts were prepared and included separately in the data base for each of the tasks. (WHK)

8730 (FE—2215-11, pp 155-171) **Task 7: MHD component and system modeling.** Jun 1978.

In Critical contributions in MHD power generation. Quarterly technical progress report, March 1-May 31, 1978.

The addition of a secondary furnace and a seed precipitator to the MHD-topped power plant simulation model is discussed. The computed results for the variation of power generated by the MHD generator and steam plant and the overall system efficiency as functions of the equivalence ratio are discussed. The development of a coal combustor code for the MHD system is considered. The model includes chemical characterization, char burning, chemical equilibration, heat transfer, and mass and heat balance. Sample results are given for a furnace of square cross section.

8731 **Considerations for MHD power generation development.** Shanklin, R.V.; Levi, E. (Dep of Energy, Div of Magnetohydrodyn). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1242-1248(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A recent inventory of the plants generating electric power in the U.S. and scheduled for construction as late as 1999 shows that 39 percent of them will employ coal as their fuel. More will be added if MHD is successfully developed. MHD power generating plants promise to meet the stringent New Source Performance Standards for emission with an overall coal pile to electrical bus-bar efficiency in excess of 50 percent. The corresponding efficiency of coal-fired plants presently scheduled for construction ranges from 32 percent to 35 percent. MHD can thus generate 50 percent more electricity per ton of coal, reducing air emissions by one-third and cutting the thermal pollution in half. This paper outlines the recent accomplishments and discusses the remaining technical issues, critical choices, and milestone demonstrations.

8732 **Proposed 40 MWe pilot plant.** Way, S. *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1249-1256(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The proposed plant would put out 40 MW of dc power from the MHD generator (39.2 MW of ac power), and have a thermal rating of 182.87 MW. Total net station electrical output, including the steam turbo generator, is about 76 MW. A two stage combustor is used with a slagging vortex gassifier first stage. The generator channel proposed is of hot wall design, slightly under 7 m. long, with 5.8 tesla field. Air preheat is 1360°K, to give a top temperature of 2700°K. A radiant direct fired recuperator would be used. Fuel assumed is a Western Pennsylvania bituminous. Seeding is by 0.7% (weight) potassium, put in as dry carbonate. This plant might be upgraded to 50/90 MW for use as a transition MHD steam power installation.

8733 **Thermal modeling of coal-fired MHD plant components.** Powe, R.E. (Miss State Univ, State College). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1257-1266(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A facility for simulating the gas stream environment in any of the steam plant components of a coal-fired MHD power plant is described. Equilibrium calculations are employed to determine gas stream chemistry at various temperatures, and a thermal model is developed for predicting the longitudinal temperature profile in the gas stream. In this model, heat transfer to the wall is considered to be by both radiation and convection, and developing temperature and velocity profiles are considered. The wall is assumed to be coated with a slag layer which is partly solid and partly flowing liquid. Performance predictions of the system under a variety of conditions are given. The thermal model should have general application to a variety of coal combustion applications.

8734 **Open-cycle MHD development.** Bomkamp, D.H. (Argonne National Lab., IL). pp 135-144 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The operation principles and technology requirements for coal-fired MHD power plants are briefly reviewed. (WHK)

8735 **Status of the US/USSR cooperative program for the development of open-cycle MHD power generators.** Tempelmeyer, K.E. (Argonne National Lab., IL). pp 159-172 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The scope of the program is outlined and joint tests in the Soviet U-25 facility are described. (WHK)

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 8729

8736 (FE—2215-11, pp 194-270) **Task 9: participation in US/USSR cooperative MHD program.** Jun 1978.

In Critical contributions in MHD power generation. Quarterly technical progress report, March 1-May 31, 1978.

MIT participation in the second test of the U-25B facility is summarized. This includes data analysis, development of a predictive code for the octagonal cross-section diagonal wall generator configuration and preparation of a joint test report. Data analysis of skin friction coefficients, fluid mechanical conditions in the channel, channel electrical performance, fluctuation data and plasma diagnos-

tic measurements is considered. The calculated local characteristics at a position in the upstream section and in the downstream section of the generator are compared with the measured characteristics. Finite electrode segmentation effects on three dimensional channels are discussed. The solution for the electrode-wall region uses a blending-function technique. The relation of the layer model solutions and the two-dimensional solutions for frame-type channels is studied.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 8008, 8729

8737 (FE—2215-11, pp 24-43) **Task 1: electrode module materials evaluation.** Jun 1978.

In Critical contributions in MHD power generation. Quarterly technical progress report, March 1-May 31, 1978.

Some details of electrochemical calculations on high temperature electrodes and slags on MHD electrodes and measurements of phase chemistry, conductivity and vaporization of electrode materials in the $(La,Sr)(Fe,Cr)O_3$-$SrZrO_3$ system are described. The laboratory studies on these super-hot wall materials indicate the best physical properties to date of electrodes with melting points greater than 2400°C.

8738 (FE—2215-11, pp 44-69) **Task 3: electrode module development.** Jun 1978.

In Critical contributions in MHD power generation. Quarterly technical progress report, March 1-May 31, 1978.

Four types of electrodes fabricated during this quarter are described. Analysis of testing results on super hot wall type electrodes is reported. The test facility operations are discussed, including facility upgrading and burner and test section modifications. Test results to study slag formation at different electrode surface temperatures are presented. Measurements of plasma conductivity and plasma temperature are given. A program to correlate skin friction and heat transfer coefficients over a cooled wall is mentioned.

8739 (FE—2215-11, pp 70-115) **Task 4: coal combustion studies.** Jun 1978.

In Critical contributions in MHD power generation. Quarterly technical progress report, March 1-May 31, 1978.

Testing of eight stage Anderson cascade impactor with a precollector for the physical separation of soot and char produced from pyrolysis of Montana Lignite is discussed. Results of experiments to determine the feasibility of Gaussian settling for the determination of soot and char are reported. A mathematical model to determine the acceptable particle size distribution for a volatile yield of at least thirty weight percent in the pyrolysis of coal by laser irradiation is discussed. A two-color optical pyrometer for use in flow furnaces is described. Ash element vaporation studies and modeling are discussed.

8740 (FE—2215-11, pp 143-153) **Task 6: studies in a disk generator.** Jun 1978.

In Critical contributions in MHD power generation. Quarterly technical progress report, March 1-May 31, 1978.

Recent work on the development of a laser interferometer for measurements of the flow structure resulting from MHD interactions and the presence of wakes in a disk generator is discussed. Both holographic and conventional techniques are being developed. Electron density measurements obtained with photomultiplier tubes and an optical multichannel analyzer are compared.

8741 **Reducing combustion air temperature variations in magnetohydrodynamic/steam power plants.** Aspnes, J.D.; Pierre, D.A.; Robles, T.C. (Univ of NH, Durham). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1236-1241(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A dynamic computer model of a magnetohydrodynamic steam power plant is used to evaluate methods for reducing temperature variations in preheated combustion air. The effectiveness of a heat capacitor in smoothing short-term temperature ripple caused by regenerative air preheater switching is discussed. In addition, the results of utilizing a control loop specifically to reduce long-term fluctuations in preheated air temperature are given. Representative computer simulations showing the effects of specific overall plant control configurations are included.

8742 **Design studies and trade-off analyses for a superconducting magnet MHD power generator system.** Chapman, J.N.; Martin, J.F.; Muehlhauser, J.W.; Petersen, C.K.; Wu, Y.C.L.; Dicks, J.B. (Univ of Tenn, Space Inst, Tullahoma). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1283-1288(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

This paper presents trade-off a. alyses of potential superconducting magnet/magnetohydrodynamic power generators used to provide a basis for selecting the characteristics of the superconducting magnet to be built for an experimental MHD power generating facility, the DOE Coal Fired Flow Facility (CFFF). The work represents a close cooperative effort between The University of Tennessee Space Institute team that developed the world's only coal fired MHD power generator and the Argonne National Laboratory team that developed and built the largest and highly successful superconducting magnet for MHD power generation, the U-25B magnet.

8743 **Superconducting magnet systems for MHD generator facilities.** Niemann, R.C. (Argonne National Lab., IL). pp 173-194 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The basic design requirements and elements of superconducting magnets for MHD generators are reviewed, and existing and planned superconducting magnets for MHD generators are discussed. (WHK)

DUCT ENGINEERING AND FLUID DYNAMICS

REFER ALSO TO CITATION(S) 8740

8744 (AD-A—070590) **Magnetogasdynamic phenomena in pulsed MHD flows. Interim summary report, 1 August 1977-31 October 1978.** Demetriades, S.T.; Markham, D.M.; Maxwell, C.D.; Oliver, D.A.; Swean, T.F. (STD Research Corp., Arcadia, CA (USA)). Jan 1978. Contract N00014-77-C-0574. 56p. NTIS PC A04/MF A01.

This report examines some of the detailed structure of magnetogasdynamic flows encountered in pulsed magnetohydrodynamic (MHD) generators. Two illustrations of magnetogasdynamic nonuniformities are considered. The first is for conventional explosive-driven MHD generators. Here we reveal the detailed structure of the deceleration of the conducting slug formed by the compression of plasma between the explosive-driven shock wave and its following contact surface. The second illustration is for steady high Magnetic Reynolds Number channel flows. Here we exhibit the nonuniform manner in which the external magnetic field is diffused into the plasma and the corresponding nonuniform deceleration of the flow.

8745 (FE—2215-11, pp 116-142) **Task 5: critical phenomena in MHD generators.** Jun 1978.

In Critical contributions in MHD power generation. Quarterly technical progress report, March 1-May 31, 1978.

Quantitative results for the time history of several important turbulence parameters are presented for a realistic initial turbulence spectrum. The general behavior at short and long times is discussed in detail and it is shown that the turbulent Hartmann number tends to a constant, independent of interaction level and Hall parameter. The design of the frame angle for a channel with fixed arbitrary transverse cross section which ensures maximum power density for a given efficiency is also considered. It is shown that such an angle design ensures the Faraday condition, average J/sub x/ = 0. This analysis is applied to a circular cross section channel.

8746 (FE—2215-11, pp 172-193) **Task 8: MHD generator modeling.** Jun 1978.

In Critical contributions in MHD power generation. Quarterly technical progress report, March 1-May 31, 1978.

Modeling of the potential distribution in the plane perpendicular to the flow direction for a linear MHD channel using the finite element method is discussed. It is noted that the finite element method easily handles complex geometric channel shapes. Results of calculations of potential for several channel geometries are given. The effect of boundary layers is shown to decrease at higher Hall parameters.

8747 **Generation aspects of weakened fusion plasma in MHD channel.** Denno, K. (NJ Inst of Technol, Newark). *J. Appl. Sci. Eng., Sect. A, Electr. Power Inf. Syst.;* **3**: No. 3, 213-224(Oct 1978).

This paper presents an analytical investigation for the generation properties of weakened fusion plasma in MHD channel up to the limiting occurence of boundary layer separation and then up to the range at which no separation can take place. Facts establish that no net generation can be delivered to the external load at electrode segments where separation of boundary layer may occur. This can set the limit of weakening fusion plasma to the level workable for the purpose of power generation. Results obtained indicated a high local conversion efficiency distribution across the MHD channel for small but non-zero magnetic Reynolds number. Also it is concluded that efficiency distribution is insensitive to channel height.

8748 **Phase transition in the condenser of an MHD converter.** Radionov, O.A. (North West Polytech Inst, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.:* No. 9, 133-136(Sep 1978). (In Russian).

A method of quantitative determination of the intensity of the process of formation of the number of the condensation nuclei I in a unit of volume is considered. The dependence of the magnitude of I on the degree of vapor oversaturation /chi/is determined by means of an engineering calculation in accordance with thermodynamic flow parameters. The necessity to make use of such difficult-to-determine quantities as the chemical potential or the number of molecules in accumulations and other elements of the statistical method are eliminated. An example of calculation of I=f(/chi/) for the case of a liquid-metal MHD converter is given.

8749 Gas-liquid slip ratio and MHD pressure drop in two-phase liquid metal flow in strong magnetic field. Saito, M.; Inoue, S.; Fujii-e, Y. (Osaka Univ, Suita-shi, Jpn). *J. Nucl. Sci. Technol. (Tokyo);* **15**: No. 7, 476-489(Jul 1978).

The gas-liquid slip ratio and the MHD pressure drop in the two-phase liquid metal flow under a strong magnetic field are treated in relation to the distributions of the gaseous phase and the fluid velocity. From NaK-N_2 two-phase experiments, it is found that: (1) The ratio of the two-phase MHD pressure drop to that of the homogeneous non-slip two-phase flow model is independent of the applied magnetic field strength and the channel geometry (ratio of wall thickness to channel width) and is presented as a function of the ratio of the gas-liquid volumetric flow rate. (2) The void distribution is affected by the applied magnetic field. The gas bubbles may be pushed away towards both side walls due to the pinch effect, resulting in the increase of the ratio of the mean void fraction to the one at the channel center with the increasing applied magnetic field. (3) The gas-liquid slip ratio is not directly dependent on the applied magnetic field strength and the channel geometry and is presented as a function of the ratio of the gas-liquid volumetric flow rate. As a result, the slip ratio decreases with the increasing system pressure and/or the decreasing mixture quality.

THERMOELECTRIC GENERATORS

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 8199, 8200, 8281

8750 (SAN—0959-T1) **Progress report No. 31 for a program of thermoelectric generator testing and RTG degradation mechanisms evaluation.** Stapfer, G.; Garvey, L. (Jet Propulsion Lab., Pasadena, CA (USA)). Jul 1979. Contract EY-76-A-03-0959. 62p. Dep. NTIS, PC A04/MF A01.

Portions of document are illegible.

Thermal conductivity measurements of the p-type and n-type selenide alloys after 19,800 hours and 6,500 hours, respectively, continue to show good agreement with the 3M Co. published data. Ingradient testing of n-legs after 8900 hours show comparable performance to the reported 3M data. Ingradient testing of p-legs at accelerated test conditions has completed 5432 hours and performance shows reasonable correlation with accelerated temperature and current gradients. This test has been discontinued to accommodate ingradient performance testing of the new design p-type legs with the Astroquartz/slurry wrap. Weight loss testing of the new design p-type TPM217 (no partition) with the Astroquartz/slurry wrap has been continued at both ingradient and isothermal test conditions. A check of one sample after 1000 hours at T/sub H/900°C and T/sub C/150°C shows a very low weight loss rate, comparable to that reported by the 3M Co. and these tests are continuing. A post-mortem examination of the RCA Reference Generator, which operated for 62,339 hours prior to failure, has been initiated and the metalligraphic analysis was completed during this report period. The remaining MHW generator, Q1-A, on test has accumulated 14,191 hours and performance remains stable. An evaluation of the performance of the Voyager 1 and 2 RTGs after 14,661 hours and 15,160 hours of operation, respectively, versus the DEGRA prediction code, continues to show good agreement.

8751 Research on the sodium heat engine. Hunt, T.K.; Weber, N.; Cole, T. (Ford Mot Co). *Proc., Intersoc. Energy Convers. Eng. Conf.:* **3**: 2011-2017(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The Sodium Heat Engine (SHE) is a new device for direct thermoelectric energy conversion. It uses the ionically conducting ceramic, β''alumina, to form a high-temperature concentration cell for elemental sodium. The vapor pressure (activity) gradient across the cell is maintained by a high temperature heat source (at 600 to 1000°C) on one side of a β''-alumina membrane and a low temperature condenser (at 100 to 200°C) on the other side. Theoretical analysis of the SHE shows that under quasi-reversible conditions the efficiency should be more than 90% of Carnot efficiency. For typical operating conditions of T_2 = 800°C, T_1 = 100°C, a specific power output of 0.7 watt/cm^2 has been achieved in test electrodes.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 8282, 8750

8752 Analytical predictions of selenide RTG power degradation. Noon, E.L.; Stapfer, G.; Raag, V. (Calif Inst of Technol, JPL, Pasadena). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 1952-1957(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A mathematical model for the performance and degradation analysis of a radioisotope thermoelectric generator using the newly developed selenide thermoelectric materials has been developed. The computerized model is quite comprehensive and enables the accurate detailing of the electrical and thermal effects that take place within the thermocouple under any desired set of operation conditions, including heat input, ambient temperature and load conditions. The paper discusses the logic flow of the computer model and presents the time and temperature dependent results for various degradation mechanisms and rates as they have been established to date.

MATERIALS, COMPONENTS, AND AUXILIARIES

8753 Selenide thermoelectric converter technology. Hinderman, J.D.; Hampl, E.F. Jr.; Ericson, R.B.; Mitchell, W.C.; Reylek, R.S.; Wald, D.A. (Minn Min and Manuf Co, Pioneering Lab, St. Paul). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 1938-1945(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The potential of selenide thermoelectric materials to offer a significant performance advantage over state-of-the-art thermoelectrics has been discussed in recent years. This paper describes recent advances in materials technology, including a characterization of the operating environmental requirements for a long-life thermoelectric generator. The reference design for the converter section of a 156-couple ground demonstration system (GDS) is presented, which was fabricated and placed on test at the end of 1977. A description of module development and component characterization leading up to the GDS design is also presented.

8754 Modified silicon-germanium alloys with improved performance. Pisharody, R.K.; Garvey, L.P. (Syncal Corp, Sunnyvale, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.:* **3**: 1963-1968(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

This paper discusses the results of a program on the modification of silicon-germanium alloys by means of small extraneous material additions in order to improve their figures-of-merit. A review of the properties that constitute the figure-of-merit indicates that it is the relatively high thermal conductivity of silicon-germanium alloys that is responsible for their low values of figure-of-merit. The intent of the effort discussed in this paper is therefore the reduction of the thermal conductivity of silicon-germanium alloys by minor alloy additions and/or changes in the basic structure of the material. Because Group III and V elements are compatible with silicon and germanium, the present effort in modifying silicon-germanium alloys has concentrated on additions of gallium phosphide. A significant reduction in thermal conductivity, approximately 40 to 50 percent, has been demonstrated while the electrical properties are only slightly affected as a result. The figure-of-merit of the resultant material is enhanced over that of silicon-germanium alloys and when fully optimized is potentially better than that of any other presently available thermoelectric material.

APPLICATIONS

8755 Recent terrestrial and undersea applications of radioisotope thermoelectric generators (RTGS). Rosell, F.E. Jr.; Vogt, J.F. (Def Syst Manage Coll, Fort Belvoir, Va). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 1969-1977(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

This paper discusses recent projects utilizing strontium-90 RTGs under diverse conditions at various global locations, and covers progress on the Navy's plutonium-fueled superbattery. The purpose of the paper is to demonstrate that RTGs provide practical, reliable sources of power for many types of applications for electronic systems in inaccessible locations, and to discuss some of the problems encountered in these applications.

THERMIONIC CONVERTERS

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 8489

8756 (COO—3056-40) **DOE/JPL advanced thermionic technology program. Progress report No. 38, February-March 1979.** (Thermo Electron Corp., Waltham, MA (USA)). 1979. Contract EY-76-02-3056. 46p. Dep. NTIS, PC A03/MF A01.

Progress on DOE tasks is reported including (1) surface and plasma investigations (surface characterization chamber experiments, spectroscopic plasma measurements, and converter theory), (2) low temperature converter development (tungsten emitter, lanthanum hexaboride collector and tungsten emitter, tungsten oxide collector), and (3) component hardware development. JPL tasks reported include high-temperature converter evaluation, advanced converter studies, and correlation of design interfaces. (WHK)

8757 **Summary of USSR thermionic energy conversion activity.** Rasor, N.S. (Rasoc Assoc, Inc, Sunnyvale, Calif). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 1904-1908(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The USSR has had a large and vigorous research and development activity in thermionic energy conversion since the modern inception of the field in the late 1950's. In addition to prolific and continuous research in the basic physics and materials technology of the converter, they have developed converters for solar, radioisotope and nuclear reactor powered applications. A complete thermionic nuclear reactor space power system was reduced to engineering practice by the USSR in 1970, and details of its operation have been reported periodically since then. Thermionic reactors are widely recognized by the Soviets as the preferred power source for space systems requiring more than 5 kWe. They are now considering the use of thermionic converters for topping fossil-fueled power plants. A brief perspective is given of the USSR thermionic conversion activity and the status of their thermionic technology relative to that in the US as perceived during a recent visit.

8758 **Prospects of thermionic power systems.** Shimada, K. (Calif Inst of Technol, JPL, Pasadena). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 1929-1935(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Research in thermionic energy conversion during the past two decades has made substantial progress, primarily in thermionic converters and associated hardware. But no large-scale system integration has ever been demonstrated, other than the TOPAZ systems in the USSR. System studies of both fossil-fuel and solar-thermionic power systems indicate that an energy cost of less than 30 mils/kWh could be achieved if converter efficiency is increased to about 30%, and the converter cost is reduced to less than $300/kW. For space thermionic systems requiring many hundreds of kilowatts of power, of primary concern is the specific weight of the power system. A specific weight less than 20 kg/kW could be achieved with converters having an efficiency of about 17.5%, a value relatively easy to obtain. This paper describes the various thermionic power systems and their performance goals. It also identifies the major elements requiring further development, reviews their current development status, and discusses their future propsects.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 8756

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 8756

8759 **Characteristics of combustion-heated thermionic diodes.** Huffman, F.N.; Gunther, B.; Miskolczy, G. (Thermo Electron Corp, Waltham, Mass). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **3**: 1898-1903(1978). (CONF-780801—P3).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Flame-heated thermionic converters require protection from the combustion environment. Ceramic and alloy materials are being evaluated for this purpose. Silicon carbide and Inconel 671 have appeared most satisfactory in combustion atmosphere tests. Experiments with variable-spaced converters have identified L605 as a promising emitter material. Flame-heated diodes using Inconel 671 have provided a power density of one W/cm^2 at an emitter temperature of 1500 K. The design and performance of such thermionic diodes are described.

APPLICATIONS

REFER ALSO TO CITATION(S) 8439, 8440

FUEL CELLS

DESIGN AND DEVELOPMENT

8760 (AD-A—070881) **Improvement of phosphoric acid fuel cell stacks. Interim technical report, August 1977-November 1978.** Abens, S.G.; Ascenzo, F.J.; Baker, B.S.; Garretson, G.; Lambrech, M. (Energy Research Corp., Bethel, CT (USA)). May 1979. Contract DAAK70-77-C-0174. 71p. NTIS PC A04/MF A01.

Phosphoric acid fuel cell components and stack assembly methods were evaluated. Electrodes with Pt loading between 0.3 and 0.9 g/sq. ft. were employed. Matrix materials were phenolic (Kynol) fibers and SiC. Graphite bipolar plates with 33% phenolic resin binder were used. Stacks were tested on hydrogen and simulated reformed methanol for up to 6,800 hours. An 80-cell (2.1 kW) stack was built and delivered to MERADCOM.

8761 (AD-A—071157) **Design and development of a 30 watt solid polymer electrolyte fuel cell power source fueled with calcium hydride. Final technical report.** Adlhart, O. (Engelhard Minerals and Chemicals Corp., Newark, NJ (USA). Research and Development Dept.). 12 Dec 1978. Contract DAAK70-77-C-0222. 26p. NTIS PC A03/MF A01.

In recent years MERDCOM has shown renewed interest in the Solid Polymer Electrolyte Hydrogen-Air Fuel Cell. It focuses on the broad spectrum of applications where power requirements are quite small ranging from fractions of a watt to a few hundred watts. Handling simplicity and versatility are of utmost importance in this power range. The SPE cell is uniquely suited. It is operative at about ambient temperatures, is rugged and has excellent life characteristics. Combined with a solid hydrogen source such as calcium hydride or magnesium high energy densities are attainable. A 24 Volt, 30 Watt device was developed under the contract consisting of a static SPE stack integrated with a hydrogen generator utilizing cartridge contained calcium hydride. Even in short missions of a few hours energy densities are well in excess of those obtained with secondary batteries.

8762 (FCR—1019) **40-kW field test power plant modification and development: Phase 1. Final report, April 1, 1977-June 30, 1978.** Brown, J.D. (United Technologies Corp., South Windsor, CT (USA)). 31 Jul 1979. Contract EC-77-C-03-1471. 81p. Dep. NTIS, PC A05/MF A01.

The objective of the Phase 1 program was to initiate design and development actions that would upgrade the 40-kW fuel cell power plant to a configuration suitable for on-site integrated energy system testing in a variety of field applications. The ensuing modifications will improve operating capability, durability and maintenance interval and lead to reduced production costs. Modification will be made in all the power plant subsystems to provide the improved capabilities. In the fuel processing subsystem, design changes will be incorporated to broaden the fuel capability to include virtually all pipeline gases and peak shave gases. This requires the addition of preprocessor components to chemically reduce oxygen in peak-shave gas and to reduce unsaturated hydrocarbons such as propylene. The activated charcoal fuel treatment used on the pilot power plant for sulfur removal will be replaced with a hydrodesulfurizer. A more active reformer catalyst will be used to increase efficiency and producibility and reduce vessel size. In the power section the latest cell technology will be utilized and the dielectric oil power plant cooling system of the pilot plant will be replaced with a 2-phase water system. This improved cooler design will result in a more uniform temperature distribution power section and improved maintainability. In the power processing subsystem the inverter is to be modified to improve power plant paralleling capability. For power plant control a microprocessor unit is to replace the electronic controller of the pilot power plant. To allow the power plant to be operated as an integrated energy system, a waste heat recovery system is to be added to the design. This system will provide heat recovery in the form of hot water.

8763 **Advances in lower cost phosphoric acid fuel cells.** Johnson, W.H.; Coykendall, R.D.; Handley, L.M.; Maricle, D.L.; Mientek, A.P. (United Technol Corp, South Windsor, Conn). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 732-737(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

During 1976 the Department of Energy sponsored a phosphoric acid fuel cell technology program which made important contributions to the fuel cell power section and fuel processor technology of the 4.8-MW Demonstrator power plant scheduled to be operated in the Consolidated Edison utility network in 1979. This program was continued for 1977 and 1978 with the principal objective of identifying improvements in phosphoric acid cell technology

and power plant design which, if developed, would permit construction of a power plant equivalent to the 4.8-MW Demonstrator, but lower in both manufacturing and operating cost. Additional effort was recently undertaken to provide technology improvements of the new ribbed substrate cell concept for the 40-kW on-site power plant development program.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 8760, 8784

8764 (DOE/ET/15381—T1) **Methodology for predicting long-term fuel cell performance from short-term testing. Quarterly technical progress report No. 1, June 6-September 5, 1979.** Hooper, M.; Maru, H.; Patel, D.; Ware, C. (Energy Research Corp., Danbury, CT (USA)). 1979. Contract AC05-79ET15381. 27p. Dep. NTIS, PC A03/MF A01.

The objective of this program is to develop a methodology for predicting long-term fuel cell performance from short-term testing, applying the perturbation technique. The technique will be experimentally and theoretically applied to the phosphoric acid fuel cell (PAFC). During the first quarter, efforts were concentrated on three main task areas: aging model development, design of experiments, and testing. The details are presented. (WHK)

8765 **Fuel cell efficiency.** Benjamin, T.G.; Camara, E.H.; Selman, J.R. Chicago, IL; Institute of Gas Technolgoy (1979). 5p. (CONF-790803—62).

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

The equations describing fuel cell efficiency of conversion of gaseous fuels at the fuel cell inlet to dc power are developed from thermodynamic principles and are presented in terms of maximum theoretical, voltage, and current efficiencies. The efficiency equation is generalized for fuel gases containing conventionally combustible species such as methane, which do not participate in the electrochemical power production. Published experimental data are used to calculate actual fuel cell efficiencies for phosphoric acid and molten carbonate fuel cells. These experimental fuel cell efficiencies are then compared with fuel cell efficiencies required to meet system (fuel processor, fuel cell, cogeneration/bottoming cycle, power conditioner) design heat rates for conversion of raw fuel to ac power.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 8762

8766 **Utility fuel cells for biomass fuel.** Lindstrom, O.; Nilsson, T.; Bursell, M.; Hornell, C.; Karlsson, G.; Sylwan, C.; Ahgren, B. (R Inst of Technol, Stockholm, Swed). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1178-1184(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The fuel cell system comprises a fuel processor for conversion of biomass and peat to hydrogen, and alkaline fuel cells. The fuel processor uses a modified steam iron process. A conceptual 100 MW plant is using so-called FC-041 2.5 MW generator units. Fuel cell cathodes consist of nickel screens embedded in PTFE bonded silver catalysts and give 1 $kAmm^{-2}$ in the range -0.11 to -0.21 V vs. Hg/HgO. Anodes with skeleton-nickel from AlNiTiMo alloys on nickel matrices operate at 1 $kAmm^{-2}$ at -0.87 V. The pseudoresistivity of the cathodes is inversely proportional to the 0.7th power of the oxygen partial pressure.

ELECTROCHEMISTRY, MASS TRANSFER, AND THERMODYNAMICS

8767 (ORNL/MIT—290) **Mass transport in molten-salt electrochemical systems.** Nwalor, J.U.; Manner, A.R. (Oak Ridge National Lab., TN (USA)). 24 Mar 1979. Contract W-7405-ENG-26. 25p. Dep. NTIS, PC A02/MF A01.

The early stages (0.1 μs - 5 sec) of EMF relaxation of a Li_2CO_3/K_2CO_3 electrolysis cell were studied with applied currents of 100 to 700 mA at 582°C after electrolysis durations of 1 s, 1, 5, and 10 min, and 1 hr. The short-term EMF decay was delimited into five regimes: the IR drop (0 to 5 μs), anodic double-layer decay (~ 75 μs), cathodic double-layer decay (~ 5 ms), an unidentified decay (~ 5 s), and a thermal gradient decay (~ 2 min). Empirical expressions are given for the regimes. The unidentified regime suggests the presence of a gaseous-diffusion-controlled process. The isolation of the electrodes and their subsequent individual investigation is suggested for future study. The incorporation of the early phenomena into a theoretical migration-diffusion-model-based EMF expression is also recommended. Coordinate transformations are suggested for the optimization of the existing computer code which solves the model.

8768 (ORNL/TM—7061) **Molten carbonate fuel cell program. Composition gradients induced by current flow in Li_2CO_3-K_2CO_3 mixtures. Progress report, July 1-December 31, 1978.** Braunstein, J.; Bronstein, H.R.; Cantor, S.; Heatherly, D.E.; Padova, J.I.; Thomas, T.M.; Vallet, C.E. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

In a molten carbonate fuel cell current flow can cause gradients in the Li/K ratio of a $LiKCO_3$ electrolyte if the cation mobilities are, as in most binary molten salt mixtures, unequal. A one-dimensional model predicts 10 to 20 percent composition gradients from estimated values of mobility, activity and diffusivity, none of which is well known. Predictions from a similar model for a system of known properties have been confirmed experimentally by electrolysis-relaxation experiments. The model calculations for carbonates appear consistent with electrolysis-relaxation measurements on fuel cell tiles, but clearly indicate the need for additional specific physical property data, especially the transference number. This report is based on the material presented at the EPRI-DOE sponsored Molten Carbonate Fuel Cell Workshop, held at Oak Ridge National Lab., October 31-November 2, 1978.

8769 **Mass transfer in a current source during circulation of a solution owing to gaseous reaction products.** Korovin, N.V.; Maksimov, G.N.; Modestov, A.V. (Moscow Power Eng Inst, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 10, 86-91(Oct 1978). (In Russian).

The problem of circulation of a reagent solution in an electrochemical current source owing to the gas fed from outside, or formed in the course of the reactions under the conditions of a two-loop scheme of reagent feeding, is formulated and solved. Relations are obtained allowing calculation of the velocity of motion of a solution depending on different design parameters of the system and the rate of gas removal. The mass transfer of the reagent in an air-hydrazine element, is investigated. Circulation of the solution in it is caused by gaseous products of the reactions taking place in the element. Relations of dependence of the flow velocities of the solution on the operating conditions of the current source are determined. A comparison of the experimntal and theoretical data confirms a satisfactory convergence of the results.

8770 **Heat transfer in phosphoric acid fuel cell stacks.** Maru, H.C.; Chi, C.; Patel, D.; Bruns, D. (Energy Res Corp, Danbury, Conn). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 723-731(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The electricity production in phosphoric acid fuel cells is accompanied by approximately equal amounts of heat generation. Removal of this heat can be accomplished by a suitable flow of feed gases or by using separate cooling loops. Advantages and disadvantages of different heat removal schemes are examined in this paper, and a unique approach is described that provides a simple but cost effective and reliable means of heat removal.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 8652, 8727, 8727, 8728

BUILDINGS

REFER ALSO TO CITATION(S) 8319, 8653

8771 (COO—4522-1) **Experimental investigation of an inexpensive sky temperature measuring device. Final report, June 1, 1977-June 30, 1979.** Karaki, S.; Brothers, P. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Aug 1979. Contract EG-77-S-02-4522. 23p. Dep. NTIS, PC A02/MF A01.

The objectives were to develop a simple approach for determining clear sky temperature from ground air temperature and absolute humidity and to develop an inexpensive device for direct measurement of sky temperature. The analytical approach taken was similar to that developed by Bliss. A simpler model to estimate sky temperature to acceptable accuracy, however, was not achieved. A simple device to measure sky temperature was designed and tested but development efforts within the means of the project were unsuccessful. It was concluded that a device that could include measurement or knowledge of the convective heat transfer coefficient rather than control or elimination of it would be an alternative approach in the development of a sky temperature measurement device. Project funds were depleted before the alternative device could be designed and tested.

8772 (INKA-Conf—78-357-001) **Use of natural gas in heat pumps fom the point of view of the gas industry.** Goldammer, D. (Thyssengas G.m.b.H., Duisburg (Germany, F.R.)). 1978. 7p. (In German). (CONF-7810209—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From VDI-short seminar on heat recovery on the public and private sector; Saarbruecken, F.R. Germany (26 Oct 1978).

The technical and economic situation of natural-gas heat pumps is described. The problem of high investment costs still remains as small systems, in particular, are still not produced in quantity. However, the gas heat pump has a good chance on the market due to its greater economy compared, e.g., to electric heat pumps. Seven gas heat pumps are in operation in West Germany at the moment.

8773 (LA-UR—79-3354) **Use of adaptive optimal control to provide energy conservation in large buildings.** Farris, D.R.; Miller, D.E. (Los Alamos Scientific Lab., NM (USA); Johnson Controls, Inc., Milwaukee, WI (USA)). 1979. Contract W-7405-ENG-36. 9p. (CONF-791222—1). Dep. NTIS, PC A02/MF A01.

From 18. IEEE conference on decision and control; Fort Lauderdale, FL, USA (12 Dec 1979).

The use of an adaptive linear regulator approach for controlling heating, ventilating, and air-conditioning (HVAC) systems in large buildings is discussed. The control manifestations of this approach are compared with those found in conventional applications. The salient features of the approach are discussed, and simulation results are presented. Implementation is discussed, and economic estimates for commercial use of this approach are also presented.

8774 (NP—24106) **Determining the energy transfer coefficient of windows.** (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Stuttgart (Germany, F.R.). Inst. fuer Bauphysik). 1978. 31p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

Solar radiation striking a window is partially transmitted, and partially absorbed in the glass. The addition of the transmission and heat loss degree is the total energy permeability degree of the window. The total energy permeation can be influenced by solar protection glass. The energy permeability conditions were tested for the internal and external solar protection glasses, each time taking into consideration simple and double windows.

8775 (RLO—2228-005-T1) **Control modules for the energy-environment sumulator. Final report.** Amend, J.R. (Montana State Univ., Bozeman (USA). Dept. of Chemistry). 31 Mar 1978. Contract EY-76-S-06-2228-005. 18p. Dep. NTIS, PC A18/MF A01.

The goal of this project was to develop alternate control modules (lap units) for the Energy-Environment Simulator. These control modules were designed to provide a quicker learning curve for participants, to develop a better understanding of the quantifiable aspects of the simulation, and to introduce conservation-oriented variables into the modeling and decision-making process. An important aspect of this work is application of the idea of distributed computation to interactive simulation. This approach permits low cost modification of the character of the simulation at any time in the life of the instrument. It also permits several different sets of variables to be considered at the discretion of the presentor. The conservation units presented in this report are representative of the potential of this approach.

8776 **Computer-aided energy design for buildings.** Arumi, F.N. pp 141-160 of Energy conservation through building design. Watson, D. (ed.). New York, NY; McGraw-Hill, Inc. (1979).

A variety of computer-aided design tools used at the Numerical Simulation Laboratory and their applicability to energy considerations in building design are discussed. The ultimate energy demand of a building is a function of time-dynamic interactions of outside climate, the building envelope, and internal loads. Computer programs that address these variables are described under the topic headings of: the dynamic thermal behavior of wall systems; insolation analysis; solar control design and testing; and integrated energy analysis. Use of these computer-aided design methods should result in energy-conserving building designs tailored to the function and local climate requirements for individual buildings. (LCL)

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 8726

8777 **Regional analysis of residential energy conservation programs.** Kurish, J.B.; Hirst, E. (Oak Ridge Natl Lab, Tenn). *J. Environ. Syst.;* **9**: No. 1, 67-87(1979).

This paper evaluates the energy and direct economic effects of implementing various residential energy conservation programs in each of the ten Federal regions. The programs considered are those proposed in the National Energy Plan: appliance efficiency targets, thermal standards for construction of new residences, and weatherization of existing housing units. Relative energy savings are highest in regions 7 and 8 (11 and 10%, respectively, of their baselines) and smallest in region 9 (7%). The net economic benefit to the nation's households of these three federal programs is $21 billion. Benefits exceed costs in each region; the benefit/cost ratio ranges from a low of 1.4 in region 10 to a high of 2.0 in region 6.

8778 (NP—24107) **Economic effects of energy conservation measures in newly erected residential buildings. Part 1.** Werner, H.; Gertis, K. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Stuttgart (Germany, F.R.). Inst. fuer Bauphysik). 1977. 89p. (In German). Dep. NTIS (US Sales Only), PC A05/MF A01.

The investigations cover a representative cross section of residential buildings, from one-family bungalows to multi-family multi-story dwellings. Different roof forms were taken into consideration, as well as corner- or centrally-located row houses and external or internal arrangements of the sanitation. When doing comparisons concerning the profitability, several heat protection stages were used. The investigations covered the amount of the necessary additional investments, the operating costs and the time required for implementation. In particular, it is concluded that the use of thermostat control valves is advantageous.

8779 **Contributions of improved technologies to reduced residential energy growth.** Hirst, E.; O'Neal, D. (Oak Ridge Natl Lab, Tenn). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 781-786(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Energy efficiencies of residential heating and cooling equipment, appliances, and structures can be significantly improved by implementing known design changes and by conducting R and D programs to develop advanced system. The Oak Ridge National Laboratory residential energy use simulation model is used to evaluate the national energy and direct economic effects of implementing the conservation programs in the proposed National Energy Plan and offering to the market advanced technologies currently being developed by private industry and the Federal government. These changes are likely to cut residential energy use by more than 60 QBtu between now and the year 2000.

TRANSPORTATION

REFER ALSO TO CITATION(S) 8653, 8775

8780 (CONF-791009—14) **Markets for new transportation technologies.** Knorr, R.E.; LaBelle, S.J.; Millar, M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The paper discusses several new-vehicle technologies currently being researched and developed. Under study are both passenger and freight vehicles that are expected to contribute toward an overall goal of reducing future-transportation energy consumption. Most of the vehicles discussed have had US government support for research and development. The likely markets and penetration levels of each technology described in the conference papers are projected for the 1990 to 2000 period. Three of the papers treat vehicle hardware programs: Stirling engines, gas turbine bus engines, and diesel bottoming cycles; the fourth describes an urban passenger-transport system modification aimed at improving access to transit stations by using battery-energized vehicles. All four programs are applicable to developed nations' transportation systems although the authors bring a perspective based on US and Canadian experience. This overview paper concludes with a presentation of energy savings that might be realized if these technologies are commercialized within the next decade.

8781 (DOE/EIA—8596-1) **Capital requirements for the transportaton of energy materials based on 1978 ARC estimates.** (TERA, Inc., Arlington, VA (USA)). Oct 1979. Contract EM-77-C-01-8596. 157p. Dep. NTIS, PC A08/MF A01.

TERA's estimates of capital requirements to transport natural gas, crude oil, petroleum products, and coal in the US by 1990 are presented. Summaries of transportation investment requirements through 1990 are tabulated for Scenarios B, C, and D. Scenario A is high supply, high demand. Scenario B is a high energy demand, low oil and gas supply case and requires most capital for transportation of all energy commodities. Scenario D requires the least amount of investment in transportation and is the opposite in terms of supply-demand pressure represented by Scenario B. Scenario D is a high oil and gas supply, low energy demand scenario. Scenario C lies predictably in the middle representing a medium case for both supply and demand. Scenario C shows the highest level of investment for oil pipelines from the other scenarios, due to a supply demand

balance favoring petroleum consumption. This second report covers chapters on natural gas, crude oil, petroleum products, and coal. The 1985 estimates given are based on an interpolation of the 1990 results from the 1978 year of reference.

8782 (UCID—18291) **Limits on oil conservation in the US transportation sector.** Austin, A.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Oct 1979. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

Conservation measures in the transportation sector are expected to significantly reduce oil consumption to help meet the national goal to reduce oil imports by about 4 million bbl/day (MBD) by 1990. These measures include increased carpooling, increased use of mass transit, enforced 55-mph speed limit, and the introduction of more fuel-efficient autos. This paper attempts to quantify the effectiveness of each. Increased carpooling and mass transit, by themselves, are inadequate conservation measures. The key to transportation energy conservation is the introduction of the efficient auto. However, because of the difference between EPA-tested new car mileage and that obtained under actual driving conditions, it is unlikely that oil consumption will reduce as expected. It is estimated that, at best, we can expect only a 1.8 to 2.7-MBD oil savings in 1990 - a considerable shortfall.

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 8089, 8639

8783 (INKA-Conf—79-093-001) **Possible energy saving by tribological measures.** Bartz, W.J. (Technische Akademie Esslingen (Germany, F.R.)). 1979. 90p. (In German). (CONF-7904115—1). Dep. NTIS (US Sales Only), PC A05/MF A01.

From UNITI technical work meeting; Stuttgart, F.R. Germany (4 Apr 1979).

Following a survey on tribologically caused losses in the Federal Republic of Germany and in the USA, possibilities are discussed on how to avoid losses in vehicle engines. The present work presents a total of 73 diagrams, illustrations and tables. The following topics are treated: possible fuel saving for vehicle engines; influences on fuel consumption; estimate of possible friction reduction using lubricants; influence of friction-reducing additives, in mixed friction; influence of the motor oil on the fuel consumption including measured results; viscosity influence; influence of friction modifiers; influence of gear lubricant oil on the fuel consumption; and influence of synthetic motor oils on the fuel consumption.

8784 (LA-UR—79-2826) **Fuel cell systems for vehicular applications.** Lynn, D.K.; McCormick, J.B.; Bobbett, R.E.; Kerwin, W.J.; Derouin, C. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 30p. (CONF-800202—2). Dep. NTIS, PC A03/MF A01.

From SAE automotive engineering congress and exposition; Detroit, MI, USA (25 Feb 1980).

The phosphoric acid fuel cell is used as the base line in these evaluations. Two cell sizes (15 and 60 kW) and two fuel options (methanol and propane) are included. Four vehicle types, the city bus, highway bus, delivery van, and general-purpose consumer car are selected for evaluation. Typical drive cycles and economics for these vehicles are compiled, and comparisons are made between the fuel-cell vehicle and current internal-combustion and diesel-engine vehicles. The conclusions of these evaluations are briefly related. Then, the initial results of two aspects of the fuel-cell-powered vehicle evaluation program ongoing at LASL are described. The first part of the program presents the results of detailed computer simulations to illustrate a number of the important system-design considerations in configuring a fuel cell/battery electric vehicle. The next program describes a fuel-cell-powered golf cart currently being used as an engineering test bed. (MCW)

SEA AND WATER

REFER ALSO TO CITATION(S) 8966

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 8653, 8775

8785 (AREAEE—206) **IBM-1620 code for calculation of isotopic composition of irradiated thorium (ISOCOM-2).** Soliman, R.H.; Karchava, G.; Hamouda, I. (Atomic Energy Establishment, Inshas (Egypt)). 1978. 23p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The present work gives a description of an IBM-1620 code to calculate the isotopic composition during the irradiation of a nuclear fuel, which initially contains ^{232}Th. The numerical results on test calculations are presented. The code has been in operation since 1968.

8786 (CONF-791009—16) **Effects of federal policy on the implementation of energy-efficient industrial technologies.** Evans, A.R.; Grogan, P.J.; Wyant, F.R. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The National Energy Act of 1978 contains several policy provisions to accelerate the implementation of energy-efficient industrial technologies. Among these are measures related to the energy-efficiency labeling of certain industrial equipment, a study for Congress on the possible effects of performance standards for energy efficiency, the establishment of industrial energy conservation tax credits, the regulation of public utilities to promote cogeneration, and the expansion of the industrial energy conservation reporting program. In some respects these policies may act independently to promote greater industrial energy efficiency. In other respects the conservation that results from one policy may affect the impact of another measure. Thus, the researcher can never totally abstract one aspect of the analysis from the others. This work discusses this larger sphere of analytical interplay while focusing on each policy option separately.

8787 (SERI/RR—333-422) **Cooperative effort for industrial energy data collection (IEDC).** Green, H.J. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1979. Contract EG-77-C-01-4042. 30p. Dep. NTIS, PC A03/MF A01.

The expanding research effort in recent years in industrial energy use has created a need for detailed data on specific industrial processes. To meet this need and eliminate multiple contacts with individual plants, a cooperative effort to collect and centralize industrial energy-use data has been organized by several solar research organizations. To date, a centralized list has been produced of industrial plants and trade associations that have been contracted, and a data format has been created for use by all organizations interested in participating in this effort.

8788 **Thirty-seventh annual meeting of Sugar Industry Technologists, Inc. Volume XXXVII. Publication of technical papers and proceedings.** Malvern, PA; Sugar Industry Technologists, Inc. (1978). 527p. (CONF-7805194—).

From 37. annual meeting of Sugar Industry Technologists, Inc; London, UK (21 May 1978).

Sixteen papers were presented at the meeting. A separate abstract was prepared for each of 3 papers. The remaining 13 papers were not in scope for the data base. (LCL)

ENERGY SOURCES

REFER ALSO TO CITATION(S) 8107, 8667, 8668, 8669, 8670, 8671, 8672, 8673, 8674, 8675, 8676, 8677, 8684, 8685

8789 (DOE/CS—0111) **Industrial Energy Efficiency Program. Annual report, July 1977-December 1978.** (Department of Energy, Washington, DC (USA)). Dec 1979. 89p. Dep. NTIS, PC A05/MF A01.

This second annual report establishes voluntary 1980 energy-conservation targets for America's energy-consumptive industries. During 1977 and 1978, America's ten most energy-intensive industries (chemicals; primary metals; petroleum and coal products; stone, clay, and glass products; paper; food; fabricated metals; transportation equipment; machinery except electrical; and textile products) achieved energy-efficiency improvements of 11 and 14%, respectively, in comparison to 1972 levels of energy efficiency. The rate of improvement in energy-use efficiency supports reasonable confidence that 1980 energy-efficiency-improvement goals for these industries will be achieved. (MCW)

EQUIPMENT AND PROCESSES

8790 (COO—4194-1) **Diffusion of energy-efficient technologies in industry. Final report.** Hsu, S.Y. (State Univ. of New York, Binghamton (USA)). 1979. Contract EC-77-S-02-4194. 263p. Dep. NTIS, PC A12/MF A01.

United States energy policies aim at cutting down dependence on foreign oil in two ways: by energy conservation and by finding new domestic supplies. The study investigates how the first goal can be achieved in the industrial sector (manufacturing) of the economy, which accounts for about 40% (about 7.3 million barrels per day) of the total energy consumption in the US. It is noted that industry is able to conserve as much as 25 to 30% of its energy consumption by adopting simple conservation measures and energy-efficient technologies. These technologies can be implemented without major alterations of the original equipment. The schools of thought on innovative processes are discussed; these will serve as the conceptual and methodological base of the project. (MCW)

8791 (COO—4881-9) **Energy savings by means of fuel cell electrodes in electro-chemical industries. Progress report, February 1, 1979-April 30, 1979.** Allen, R.J.; Juda, W.; Lindstrom, R.W. (Prototech Co., Newton Highlands, MA (USA)). 10 Jul 1979. Contract ET-78-C-02-4881. 60p. Dep. NTIS, PC A04/MF A01.

Data are presented for investigations involving air cathodes in caustic half cells and hydrogen depolarized anodes for metal electrowinning (acid electrolytes). Studies with air depolarized Pt cathodes in caustic hardware include: progress of the RA19 type air diffusion electrode. Reference data has been obtained with this 10,500 hour old electrode; cathode performance (Reference) vs time for a standard 0.33 mg/cm^2 cathode; electrode-current collector evaluation; electrode-current collector data as a function of cell temperature; and electrode-current collector data as a function of CO_2 free air efficiency. Zinc electrowinning data have been obtained for tests involving: current density vs power consumption; current efficiency over the temperature range of from 55 to 80°C; and the presence of Co, Fe, Cu, Ge, and Pt impurities in the electrolyte.

8792 (COO—4929-2) **Use of precalciners to remove alkali from raw material in the cement industry. Quarterly technical progress report, November 1978-January 1979.** Gartner, E.M. (Portland Cement Association, Skokie, IL (USA). Construction Technology Labs.). Feb 1979. Contract EM-78-C-02-4929. 32p. Dep. NTIS, PC A03/MF A01.

The attached reports deal with the results of: (1) a literature survey on the general topics of alkali volatilization and heat transfer in cement manufacturing systems, (2) a survey of on-line gas analysis techniques for alkalies, sulfur and chlorine, and (3) a series of high-temperature burns of selected ground argillaceous minerals with various chloride-containing admixtures. Little further information regarding the volatility of alkalies in pure minerals was found. The survey of on-line gas analysis techniques for alkalies, etc., has shown that no techniques have as yet been developed to the stage where they can be used in cement kiln system. However, developments in this area might be expected to occur rapidly in the next few years. The experimental work has been successful in showing that the combined addition of $CaCO_3$ and $CaCl_2$ to several of the minerals enhances alkali volatility at 1000°C relative to addition of $CaCl_2$ alone, although the degree of alkali loss rarely exceeds about 50%. The greatest success was achieved with the feldspars, which also performed well with additions of a $MgCl_2/NH_4Cl$ mixture. The illite and muscovite results generally were more difficult to interpret. The kaolin and montmorillonite actually showed gains in alkali content in many of the burns, probably due to a weakness in the experimental method. As a result, future experiments will, where possible, be conducted in a tube furnace, in a flowing gas stream, to avoid sample contamination. Further work will also include the use of $FeCl_3$ and HCl vapors in controlled atmospheres.

8793 (DOE/CS/2123—T2) **Computer technology: its potential for industrial energy conservation. A technology applications manual.** (Centec Consultants, Inc., Fort Lauderdale, FL (USA); Centec Consultants, Inc., Reston, VA). 1979. Contract EX-76-C-01-2123. 64p. Dep. NTIS, PC A04/MF A01.

Today, computer technology is within the reach of practically any industrial corporation regardless of product size. This manual highlights a few of the many applications of computers in the process industry and provides the technical reader with a basic understanding of computer technology, terminology, and the interactions among the various elements of a process computer system. The manual has been organized to separate process applications and economics from computer technology. Chapter 1 introduces the present status of process computer technology and describes the four major applications - monitoring, analysis, control, and optimization. The basic components of a process computer system also are defined. Energy-saving applications in the four major categories defined in Chapter 1 are discussed in Chapter 2. The economics of process computer systems is the topic of Chapter 3, where the historical trend of process computer system costs is presented. Evaluating a process for the possible implementation of a computer system requires a basic understanding of computer technology as well as familiarity with the potential applications; Chapter 4 provides enough technical information for an evaluation. Computer and associated peripheral costs and the logical sequence of steps in the development of a microprocessor-based process control system are covered in Chapter 5.

8794 **Energy savings in cane sugar refineries.** Buckland, W.G.N. (Tate and Lyle Refineries Ltd., London, England). pp 132-280 of Thirty-seventh annual meeting of Sugar Industry Technologists, Inc. Volume XXXVII. Publication of technical papers and proceedings. Malvern, PA; Sugar Industry Technologists, Inc. (1978).

From 37. annual meeting of Sugar Industry Technologists, Inc; London, UK (21 May 1978).

The World's energy demand is outlined in relation to British Reserves and the present policy of conservation. How to begin an energy saving campaign is discussed. Cane sugar refineries have led the world in private power generation and the concept of total energy. Thames Refinery's conversion from coal to natural gas is discussed and related to the maintaining of good boiler efficiencies. Power Steam ratio problems are studied and methods suggested for cures. The importance of all service costs is stressed in order to aim for the energy audit. Regression analysis for production targets are derived in relation to a weekly energy balance. Speed control of simple electric drives are described in relation to computerized refinery control. The hourly production rate should be optimized in relation to the production required to minimize costs. An attempt is made to assess energy usage on various evaporation methods. Various ideas for heat saving and possible other energy sources are mentioned.

8795 **Air heaters and economizers.** VanTreese, C.R. pp 281-285 of Thirty-seventh annual meeting of Sugar Industry Technologists, Inc. Volume XXXVII. Publication of technical papers and proceedings. Malvern, PA; Sugar Industry Technologists, Inc. (1978).

From 37. annual meeting of Sugar Industry Technologists, Inc; London, UK (21 May 1978).

Problems of fouling and corrosion in air preheater tubes and economizer tubes are discussed, and methods for preventing these problems by minimizing combustion product condensation through the proper design, operation and maintenance of this equipment are suggested. (LCL)

8796 **Look at the Savannah Sugar Refinery's Energy Conservation Program.** VanTreese, C.R. pp 310-332 of Thirty-seventh annual meeting of Sugar Industry Technologists, Inc. Volume XXXVII. Publication of technical papers and proceedings. Malvern, PA; Sugar Industry Technologists, Inc. (1978).

From 37. annual meeting of Sugar Industry Technologists, Inc; London, UK (21 May 1978).

In April 1976, the Savannah Sugar Refinery created its Energy Conservation Committee, whose primary objective was to reduce the refinery's annual fuel bill through the following: improvements in steam and electrical usages for shutdown operations; a reduction in steam exhausted to atmosphere created by an imbalance in plant steam demand and turbogenerator throttle flow; increased efficiency and maintenance programs for energy intense process equipment; careful monitoring and evaluating of daily plant performance; process changes as needed; and continually researching possible economic incentives offered by alternative fuel sources. The energy accounting procedures used to identify energy-wasteful plant operations and steps taken to minimize energy waste are described. A substantial reduction in the refinery's fuel usage was accomplished without any significant capital expenditures for new energy saving equipment. This reduction resulted in a savings of over $1,000,000 within two years of implementing the energy conservation program. (LCL)

8797 (CONS—2123-T1) **Developing software for energy conservation in the process industries: executive briefing report.** (Centec Consultants, Inc., Reston, VA). [nd]. Contract EX-76-C-01-2123. 73p. Dep. NTIS, PC A04/MF A01.

The process industries provide many opportunities where computers can be used to assist in the reduction of energy use. The areas are monitoring, analysis, control, and optimization. Since the process industries consist of a variety of combinations of specialized technology, the plants are not suitable for mass produced software which would be broadly applicable. Software development for this industry requires a careful step-by-step analysis of specific applications in close cooperation with industry specialists. Once installed and operating, however, the continuous high throughput nature of manufacturing in those industries creates a situation where applied computer technology can provide very large returns on investment.

8798 (CONS—2123-T2) **Developing software for energy conservation in the process industries: two case studies. Capsule report.** (Centec Consultants, Inc., Reston, VA). [nd]. Contract EX-76-C-01-2123. 19p. Dep. NTIS, PC A02/MF A01.

Increases in energy cost occurring simultaneously with greatly decreasing computer costs have opened opportunities for applications of computers for industrial energy conversation. The documentation of savings related to past projects is a useful first step in determining the most attractive future applications of computers. The use of computers in the control of a textile dyehouse and in the drying of citrus pulp and the resulting economic gains and energy conservation in these applications are discussed. The overall impact of the control system in the dyehouse was a 23% increase in production per unit of resource consumed, and a payback period for the control system of less than two years. In the drying operations process reliability and safety improved, fuel consumption decreased and production yield increased. (LCL)

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 8795, 8796

8799 (CONF-791009—15) **Commercialization and implementation of industrial energy conservation technology.** Grogan, P.J.; Evans, A.R.; Wyant, F.R. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

This paper outlines a method of analysis for the commercialization and implementation of waste-heat recovery technologies in industry. A fluidized-bed, waste-heat boiler was selected as an example of a specific waste-heat recovery option, and its technical, market, and economic aspects are discussed. The methodology, although presented for this particular technology, can be applied to other technologies and has attributes helpful in the planning of research and development in energy conservation technology, as well as other areas.

8800 (INKA-Conf—78-356-004) **Utilization of waste gas steam condensation.** Kremer, R. (Froeling G.m.b.H. und Co., Overrath (Germany, F.R.)). 1978. 8p. (In German). (CONF-7810220—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on heat recovery and waste heat utilization in industrial plants; Stuttgart, F.R. Germany (6 Oct 1978).

The use of waste heat from internal combustion engines belongs with the energy concept of combined heat-power plants, and increases the chances of fuel-driven heat pumps in heat pump installations. In both cases the further use of waste gases through steam condensation and reduction of the sensible heat down to the lowest possible temperature level is shown. Existing plants show that 17.5% maximum additional energy utilization, i.e., a 17.5% energy savings, is possible. A precondition is that at least one part of the waste-gas heat exchanger operates in the temperature range below 40°C. These operating conditions can be met with gas heat pump systems. According to the type of installation, Recitherm-Combustion equipment, which operates on the principle of off-gas scrubbers, or heat exchangers with media-isolating heat surfaces can be used. In both cases requirements for maintenance-free and corrosion-proof operation must be fulfilled. The new technology of gas heat pumps and of combined heat-power plants includes cooling water and off-gas heat recovery equipment which should be delivered from the engine manufacturer already integrated into the unit.

8801 (OA-tr—2226) **Space heating by heat recovery from extruding machines by means of a heat pump.** Burugorri, R.; Issaly, R. (Electricity Council, London (UK)). Aug 1978. Translation of paper presented by Comite Francais d'Electrothermie to Journees d'Informations Electro-Industrielles de la Region Sud-Ouest, Bordeaux, 10-11 May 1978. 11p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Portions of document are illegible.

At the French firm of Burugorri-Soule-Lorette there was an opportunity to improve the cost of running the heating of the workshops by using warm water (15 to 25°C) leaving the extruding machines. The adoption of a WATER/WATER heat pump in existing premises, in order to ensure the heat transfer, has enabled the free heat to be recovered under excellent conditions for heating the workshop.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 8995, 8999

8802 (AD-A—070519) **Hazards analysis of energy recovery from army ammunition plant solid waste. Final report.** Scola, R. (Army Armament Research and Development Command, Dover, NJ (USA). Large Caliber Weapon Systems Lab.). Apr 1979. 35p. NTIS PC A03/MF A01.

The generation of large quantities of solid waste at Army Ammunition Plants provides a potential fuel source to reduce dependence on costly fossil fuels. The current methods of disposing of this waste don't take advantage of the 15.7 MJ/kg heat content of the waste. The report discusses the potentially hazardous conditions of processing this waste for use as a fuel.

8803 (STU—75-5768) **Utilization of the waste products from the forest industry as raw materials for the production.** Kringstad, K. (Svenska Traeforskningsinstitutet, Stockholm (Sweden)). Feb 1977. 68p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

The economic and marketing possibilitiesof industrial production of chemicals and/or proteins by utilizing waste liquor from processes at pulp mills or bark and needles was investigated. A survey of known processes for such production is given. The costs of producing several chemicals and proteins were estimated and compared with costs of producing these products via petrochemistry. The present as well as the future market of the different chemicals and of proteins were estimated. The present investigation was performed due to the rapidly increasing oil prices.

8804 **Gaseous molecular seal for flare stack.** Schwartz, R.E. (to John Zink Co.). US Patent 4,154,570. 15 May 1979. Filed date 12 Sep 1977. 10p.

The invention is concerned with the field of waste or dump gases in flare systems. The primary object of this invention is to provide a molecular seal which would limit the entry of atmospheric air into the top end of a flare stack, and into a selected portion of the molecular seal. Air must be prevented from entering the molecular seal too far in order to coming into contact with waste gases and forming combustible mixtures. The design of the molecular seal is described. 11 claims.

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 8640

8805 (CONF-791009—18) **Optimization and simulation of integrated systems.** Rabl, V.A.; Calm, J.M.; Bingaman, D.J.; Cumali, Z.O.; Davis, P.K.; Adler, I. (Argonne National Lab., IL (USA); Consultants Computation Bureau, Oakland, CA (USA)). 1979. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

A computer program, OASIS (Optimization and Simulation of Integrated Systems), is presented for use in the analysis and design of community energy systems. This program provides a highly flexible and inexpensive method to simulate energy systems according to user defined operating strategies or to optimize the plant operation either with respect to user selected resource weighting or minimized operating and maintenance costs. The plant operation is simulated as a quasi-steady state process at discrete time intervals, generally hourly, for periods selected by the user. The energy system configuration is input in a semi-conversational language as a network of equipment modules linked by energy forms. OASIS outputs include graphical and tabular analyses of energy utilization, system performance, and economics. The OASIS optimization algorithm is based on a heuristic approach to the fundamental nonlinear mixed integer problem. It first simplifies the network formed by the equipment and energy pool nodes and then constructs a nearly feasible solution for the complete network.

8806 (DOE/TIC—10117(Vol.1)) **Phase 1: integrated community energy plan for Riverside, California. Volume 1. Final report.** (Battelle Columbus Labs., OH (USA)). Jan 1979. Contract W-7405-ENG-92-100. 248p. Dep. NTIS, PC A11/MF A01.

The objective of this study was to develop an integrated energy plan for Riverside, CA. Baseline information was collected regarding energy consumption patterns, current environmental conditions, conservation activities, indigenous alternative energy resources, legal/institutional factors and existing educational programs. Candidate conservation and alternative energy supply options were identified and screened. Alternative energy strategies, including conservation and alternative energy options, were recommended and evaluated in terms of energy savings, environmental impacts, and feasibility. It was determined that under a high impact assumption in the year 2000, purchased energy for Riverside based on natural gas and oil could be about one-half of that in 1976 and about one-third of that in 2000 on a business-as-usual basis. Business-as-usual was defined as: no significant changes in per capita consumption of energy or lifestyle between 1976 and 2000. Projected demand would be reduced by means of conservation and alternative energy resources including (1) a coal and refuse-fired integrated utility system which would supply steam and electricity, (2) solar energy for residential use, and (3) some methane recovery from waste for general heating use. Hydrogen, produced by electrolysis, would be used in Riverside's municipal fleet. The benefits expected in the year 2000 if the recommended maximum strategy and action plan are implemented are: a high degree of reliability of energy supply; a reduced dependence on electric utility power; reduced total energy costs to the consumer; and a minimum risk, because of the use of proven technology.

8807 (DOE/TIC—10117(Vol.2)) **Phase I. Integrated community energy plan for Riverside, California. Volume 2. Final report.** (Battelle Columbus Labs., OH (USA)). Jan 1979. Contract W-7405-ENG-92-100. 362p. Dep. NTIS, PC A17/MF A01.

This volume on the feasibility study of an integrated energy plan for the city of Riverside, CA contains information on the overall methodology for developing an integrated community energy system (ICES) for Riverside, CA; characterization of energy consumption and needs of the community of Riverside, CA; energy conservation options in buildings; energy conservation options in industry; energy conservation options in transportation; and energy conservation options in community design. (RCK)

8808 (DOE/TIC—10117(Vol.3)) **Integrated community energy plan for Riverside, California, Phase I. Final report.** (Battelle Colum-

bus Labs., OH (USA)). Jan 1979. Contract W-7405-ENG-92-100. 338p. Dep. NTIS, PC A15/MF A01.

This appendix to the feasibility study of an integrated energy plan for the City of Riverside, CA contains information on alternative energy supplies including coal, solar, geothermal, nuclear, biomass, wind and hydrogen energy sources in California; purchased fuel prices, an analysis of various options for an integrated community energy system (ICES) and an assessment of the environmental impact of an ICES; legal and institutional aspects of ICES; environmental quality regulations; public opinion and community involvement activities; and results of an infrared photographic survey of Riverside. (LCL)

8809 **Economic analysis of decentralized energy systems.** Kennedy, A.S.; Sewell, I.O.; Lee, C. (Argonne Natl Lab, Ill). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **1**: 902-908(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Economic viability is a necessary condition for the implementation of an energy-conserving. Integrated Community Energy Systems (ICES) concept. The criterion is inextricably linked to: the costs of installing, operating, and maintaining competitive systems; the costs of energy systems to the individual building owners and occupants in the community; the amount, type, and relative prices of fuels and electric rates; and the access of ICES owners to capital markets. This paper discusses procedures whereby ICES concepts can be economically evaluated and consistently compared.

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 8634

8810 (CONF-791009—21) **Conservation potential of heat-pump-centered district heating and cooling.** Calm, J.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Over one quarter of the energy consumption in the United States is used to heat and cool buildings and to heat water. Approximately 83% of the energy for these services is supplied from natural gas and oil, both of which are becoming scarce resources. District heating and cooling systems using heat pumps to recover otherwise wasted and low-grade natural heat show potential to reduce net energy consumption by 20 to 50% in meeting these demands. Such heat-pump-centered systems also afford wide latitude in fuel selection and enable fuel substitution with non-scarce resources not practical in smaller, individual building systems. At the same time, environmental pollution can be reduced by incorporating improved emission controls not viable in smaller systems and by increasing conversion efficiencies.

8811 (CONF-791009—22) **Indirect capital costs of heating alternatives for northern cities.** Santini, D.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

This paper estimates indirect capital costs which would result from the construction of alternative energy facilities designed to serve the same final heating demand. The comparison specifically focuses on heating services to the center cities of major northern US metropolitan areas. District heating is compared to high-Btu coal gasification and electricity. It is shown that significant differences in indirect public and private sector capital requirements result from differences in placement of capital stock. The district-heating system places a much higher proportion of its capital structure within the actual service area than do the two alternative technologies. The electric and coal-gasification technologies are more likely to be constructed in rural areas where new public and private (housing and business) capital investment must occur. However, in spite of extreme differences in these indirect costs, it is found that the relative magnitude of these costs are not great when compared to direct costs.

8812 (CONS—2686-T1(Vol.2)) **Case-study application of venture analysis: the integrated energy utility. Volume 2. Technical report.** Fein, E.; Gordon, T.J.; King, R.; Kropp, F.G.; Shuchman, H.L.; Stover, J.; Hausz, W.; Meyer, C. (Futures Group, Glastonbury, CT (USA); General Electric Co., Santa Barbara, CA (USA)). Nov 1978. Contract EX-77-C-01-2686. 311p. Dep. NTIS, PC A14/MF A01.

Application of venture analysis would, at a minimum, need to address issues involving careful definition of the product/service being considered; market needs that the product will satisfy; investment/manufacturing costs; minimum selling price needed to achieve desired ROI or other financial measure; market potential at relevant prices; potential for competitors to obsolete the product before investment is recovered; assessment of companies' resources and capabilities to supply the product. There is clearly no single method for performing every venture analysis, because the economic and structural environment associated with each industry varies widely. These and other factors produce differences in cost structure, marketing organizations, and nature of products which dictate that an appropriate method of venture analysis must be tailored to each industry. The initial chapter of the report presents some brief remarks concerning the important concepts that all venture analyses must consider and then describes in detail the method used for the venture analyzed in this report. The case study addresses IEUS for commercialization. The type of IEUS investigated supplies electricity and thermal energy; the thermal energy distributed in the form of high-temperature water, i.e., water from at least 90°C upwards to 200°C. (MCW)

8813 (CONS—2686-T1(Vol.3)) **Case-study application of venture analysis: the integrated energy utility. Volume 3. Appendices.** Fein, E.; Gordon, T.J.; King, R.; Kropp, F.G.; Shuchman, H.L.; Stover, J.; Hausz, W.; Meyer, C. (Futures Group, Glastonbury, CT (USA); General Electric Co., Santa Barbara, CA (USA)). Nov 1978. Contract EX-77-C-01-2686. 203p. Dep. NTIS, PC A10/MF A01.

The appendices for a case-study application of venture analysis for an integrated energy utility for commercialization are presented. The following are included and discussed: utility interviews; net social benefits - quantitative calculations; the financial analysis model; market penetration decision model; international district heating systems; political and regulatory environment; institutional impacts.

8814 (COO—4981-1(Vol.3)(App.)) **District heating and cooling systems for communities through power plant retrofit and distribution networks. Phase 1: identificaion and assessment. Final report.** (Wisconsin State Energy Office, Madison (USA)). Sep 1979. Contract EM-78-C-02-4981. 225p. Dep. NTIS, PC A10/MF A01.

Appendix A, Utility Plant Characteristics, contains information describing the characteristics of seven utility plants that were considered during the final site selection process. The plants are: Valley Electric Generating Plant, downtown Milwaukee; Manitowoc Electric Generating Plant, downtown Manitowoc; Blount Street Electric Generating Plant, downtown Madison; Pulliam Electric Generating Plant, downtown Green Bay; Edgewater Electric Generating Plant, downtown Sheboygan; Rock River Electric Generating Plant, near Janesville and Beloit; and Black Hawk Electric Generating Plant, downtown Beloit. Additional appendices are: Future Loads; hvac Inventory; Load Calculations; Factors to Induce Potential Users; Turbine Retrofit/Distribution System Data; and Detailed Economic Analysis Results/Data.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 8993, 8994, 8995

8815 (DOE/TIC—10164) **Dutchess County Pyrolysis Project. Draft summary report, organizational and financial considerations.** Wing, S.J.; Amodeo, M.P. (Dutchess County Pyrolysis Project, Poughkeepsie, NY (USA)). Jun 1979. Contract EM-78-G-01-5143. 25p. Dep. NTIS, PC A02/MF A01.

One of the major steps in implementing a resource recovery project is the development of the organizational frame within which the project will be carried out. Attendant to that consideration is a decision as to the method of financing the project. These two matters are discussed using the assumption that the project will be developed as a county-owned project, and will not be a private development. It is recommended that the State create a public authority with local country appointed officers to carry out this project and to obtain the necessary financing. (LCL)

EDUCATION AND PUBLIC RELATIONS

8816 (DOE/TID/6037—1) **Review and evaluation of DOE energy education curriculum materials.** (Battelle Columbus Labs., OH (USA)). Oct 1979. Contract EG-77-C-01-6037. 58p. Dep. NTIS, PC A04/MF A01.

Current projects in progress are reviewed and evaluated; existing curriculum materials are evaluated; and DOE's energy education program is evaluated. Results from accomplishments of the reviews and evaluations are presented along with conclusions and recommendations. The following projects in progress are reviewed: Solar Curriculum, K-6; Easy Energy Reader, 7-12; Ten Interdisciplinary Units; Four Disciplinary Units; Electric Power Generation; Vocational Education Curriculum; Energy Conservation; and Energy Education Workshop Handbook. (MCW)

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 8780

8817 (CONF-790854—, pp 458-464) **Regenerative braking through elastomeric energy storage.** Hoppie, L.O. (Eaton Corp., Southfield, MI). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

A theoretical and experimental investigation into the use of elastomers as the energy storage element of a regenerative braking system for urban vehicles was carried out. This work culminated in the preliminary design of a complete full-scale system, the prediction of its performance and efficiency, the specification of its control system with the required actuators and sensors, and an analysis of its possible failure modes. The results of this work indicate that such a system could be constructed from materials and components requiring neither new technology nor major development, but significant engineering problems need to be carefully addressed. Incorporation of the system would result in a savings of prime energy required at the drive line of at least 18% for the EPA Urban Driving Cycle, and would be cost effective if it can be manufactured and sold at less than about 12% of the selling price of the vehicle for which it is intended.

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 8830

8818 (AD-A—070528) **Technology assessment of advanced propulsion systems for some classes of combat vehicles. Volume 2. Appendices A-F. Final report.** Riddell, F.R.; Dix, D.M. (Institute for Defense Analyses, Arlington, VA (USA). Science and Technology Div.). Sep 1978. Contract DAHC15-73-C-0200. 354p. NTIS PC A16/MF A01.

Contents: Relationship of Propulsion System Parameters to Land Combat Vehicle Characteristics; Relationship of Propulsion System Parameters to the Characteristics of High-Speed Ships; Size and Specific Fuel Consumption Relationships in Otto-Cycle Engines; Size and Specific Fuel Relationships for Diesel Engines; Size and Fuel Consumption Relationships for Open Brayton-Cycle Engines; and Size and Specific Fuel Consumption Realtionships for Closed Brayton-Cycle Engines.

8819 (AD-A—070529) **Technology assessment of avanced propulsion systems for some classes of combat vehicles. Volume 3. Appendices G-M. Final report.** Riddell, F.R.; Dix, D.M. (Institute for Defense Analyses, Arlington, VA (USA). Science and Technology Div.). Sep 1978. Contract DAHC15-73-C-0200. 284p. NTIS PC A13/MF A01.

Partial Contents: Size and Specific Fuel Consumption Relationships for Stirling Engines; Mechanical and Fluid Mechanical Transmissions for Propulsion of Land combat Vehicles and High-Speed Ships; Assessment of the Technology of Electric Transmission Subsystems for Surface Vehicles; Thrusters for Ground Combat Vehicles; and Thrusters for High-Speed Oceangoing Ships.

8820 (SAND—79-8685) **Critical comparison of hot-wire anemometry and laser Doppler velocimetry for I.C. engine applications.** Witze, O.P. (Sandia Labs., Livermore, CA (USA)). Sep 1979. Contract EY-76-C-04-0789. 30p. (CONF-800202—1). Dep. NTIS, PC A03/MF A01.

From SAE automotive engineering congress and exposition; Detroit, MI, USA (25 Feb 1980).

Hot-wire anemometer and laser Doppler velocimeter measurement have been taken in a motored reciprocating engine and compared to access the validity of hot-wire measurements. The procedure used to account for the sensitivity of the hot wire to changes in the gas temperature is extensively investigated. The results presented show that for the optimum conditions of known flow direction, low turbulence level, and low compression ratio, the hot-wire anemometer can provide useful mean velocity results. Accurate hot-wire turbulence intensity measurements appear to be possible only for the intake and exhaust strokes.

8821 **Prospects for internal combustion engines among advanced energy conversion systems.** Oppenheim, A.K. (Univ of Calif, Berkeley). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1192-1200(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The position of internal combustion engines as major prime movers for transportation is examined. Advantages, associated with their impressively high level of flexibility and reliability are reviewed, and the disadvantages, due to their harmful environmental effects and relatively poor fuel economy, are outlined. The former are ascribed to the intrinsic superiority of both the internal combustion system as the most convenient heat source for an energy conversion cycle and the oil fuel as the most compact energy accumulator. The latter are shown to be related primarily to the conditions under which the combustion process is performed. In principle, significant improvements could be made in this respect if combustion chambers could be developed that would serve not only as heat sources, but also as chemical reactors yielding acceptably low concentration of pollutants in the exhaust products. Fundamentally the recipe for this purpose is quite straightforward: operation with a completely pre-evaporized, homogeneously pre-mixed, and extra-lean charge. In practice, however, the attainment of this goal is riddled with difficulties.

EXTERNAL COMBUSTION ENGINES

STIRLING CYCLE

8822 (DOE/NASA/0032—79/4) **Assessment of the state of technology of automotive Stirling engines.** (Mechanical Technology, Inc., Latham, NY (USA). Stirling Engine Systems Div.). Sep 1979. Contract EC-77-A-31-1040. 334p. (NASA-CR—159631; MTI—79ASE77RE2). Dep. NTIS, PC A15/MF A01.

The report is intended to be an assessment in the true sense of the word, and not a status report. It presents the history of Stirling engine development, explains the current status of the technology and the developments leading to this state. Where possible, it projects the direction which should be taken to improve technology for the ultimate use of Stirling engines in automotive applications. (TFD)

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 8824, 8825, 8826

8823 (DOE/CS/2566—1) **Ford/DOE sodium-sulfur battery electric vehicle development: Phase I-A final report.** (Ford Motor Co., Dearborn, MI (USA)). Dec 1979. Contract EY-76-C-02-2566. 193p. Dep. NTIS, PC A09/MF A01.

Phase I-A NaS battery powered electric vehicle study program produced encouraging results insofar as showing that a feasible NaS battery design can be developed for installation in an existing production vehicle, such as the Ford Fiesta. The study has shown that this NaS Battery powered Fiesta (modified to be a 2-passenger vehicle), can have adequate performance and range potential such that its use as a test bed could adequately evaluate the potential of the NaS battery as a power source for further electric vehicles.

HYBRID SYSTEMS

8824 (CONF-790854—, pp 466-477) **Electric/flywheel powered postal vehicle development program.** Raynard, A.E. (AiResearch Manufacturing Co. of California, Torrance). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

A review of the DOE/USPS/AiResearch electric battery/flywheel powered DJ5E Postal Vehicle development program is included. The program goals are stated. The design and development of the flywheel energy storage unit including a description of the components is reviewed. The program status, including development problems and solutions, is discussed. A DJ5E Postal Vehicle has been modified by removal of the dc electric motor and controller, and a flywheel power unit replaces the original system. The new propulsion system features a small steel flywheel, a brushless dc motor, and a mechanical vari-belt transmission.

8825 (CONF-790854—, pp 480-486) **Regenerative flywheel energy storage system.** Lustenader, E.L.; Edelfelt, I.H.; Jones, D.W.; Plunkett, A.B.; Richter, E.; Turnbull, F.G. (General Electric Co., Schenectady, NY). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The paper describes the current status of a program to develop and evaluate a regenerative flywheel energy storage system. The system has been designed for a battery/flywheel electric vehicle in the 3000 pound class. Planned laboratory tests will simulate this electric vehicle operating over the SAE J227a Schedule D driving cycle. The range improvement attributed to the use of the flywheel will be established. The flywheel energy storage system will consist of a solid rotor, synchronous inductor-type flywheel drive machine

electrically coupled to a dc battery electric propulsion system through a load commutated inverter. The motor/alternator unit is coupled mechanically to a small steel flywheel which provides a portion of the vehicle's accelerating energy and regenerates the vehicle's braking energy. The laboratory simulation of the electric vehicle propulsion system will include a 108 volt lead-acid battery bank, a separately excited dc propulsion motor coupled to a flywheel which simulates the vehicle's inertia, and the flywheel energy storage system comprised of the motor/flywheel unit, the load commutated inverter and its control.

8826 (CONF-790854—, pp 488-499) **LLL/AiResearch advanced energy storage unit development program.** Norrup, L.V. (AiResearch Manufacturing Co. of California, Torrance). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The paper includes a review of the LLL/AiResearch advanced flywheel energy storage unit (ESU) development program. The program scope and goals are stated. A description of each of the major hardware subassemblies is included. The development test program tasks are defined and a summary of the testing in terms of status, development problems, and corrective actions is discussed. The energy storage unit is a self-contained, hermetically sealed, package that features a light-weight composite material flywheel and a high-power density electrical input/output machine. The ESU was designed for a vehicular application.

8827 (CONF-790854—, pp 502-509) **Comparison of alternative heat engines for flywheel mechanical transmission automobiles.** Frank, A.A.; Beachley, N.H. (Univ. of Wisconsin, Madison). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The feasibility of various heat engines to be used with a flywheel-transmission are investigated. Four possibilities are considered: (1) gas turbine; (2) Stirling engine; (3) gasoline piston engine; and (4) diesel piston engine. These four heat engines are studied to assess their fuel economy capability with one specific flywheel-transmission combination. Their relative fuel economies are compared for engines unmodified from present design. Design changes possible with each engine are further explored. These changes would improve efficiency, save weight, simplify and reduce the cost of the engine. The preliminary simulations for the EPA-CVS Federal Urban Driving Cycle (FUDC) with a 3,000 lb vehicle show the following mpg values (gasoline equivalent) based on engine maps available in the literature: (1) Turbine - 47.9 mpg; (2) Stirling - 51.3 mpg; (3) Gasoline - 41.2 mpg; and (4) Diesel - 41.2 mpg. Project improvements are discussed.

FLYWHEEL PROPULSION

REFER ALSO TO CITATION(S) 8598, 8824, 8825, 8826, 8827

8828 (CONF-790854—, pp 440-447) **Mechanical continuously-variable transmission designs for flywheel energy-storage automobiles.** Beachley, N.H.; Frank, A.A. (Univ. of Wisconsin, Madison). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

In order to further investigate the concept of an energy storage flywheel powerplant system, a second-generation experimental automobile is planned. The purpose of the vehicle will be to demonstrate the commercial potential of the concept, its performance and fuel-saving characteristics, and to serve as a test bed for further research and development of the basic concept. Three continuously-variable transmission concepts are being evaluated and compared to determine the best design to use in the experimental automobile. They are: (1) multi-speed gearbox with slipping clutch system; (2) hydrostatic power-split system; and (3) van Doorne steel V-belt system. The major transmission requirements are: (1) minimum energy losses under urban driving conditions; (2) low weight and a size envelope that allows compact packaging; and (3) the capability of having torque control, and automatic control of all other required functions. The three concepts being considered all appear attractive, and will be carried through to an assembly drawing stage with concurrent analysis before a final choice is made for the construction of the experimental model.

8829 (CONF-790854—, pp 450-456) **Vehicular applications of mechanical energy storage: FY79.** Crothers, W.T. (Lawrence Livermore Lab., CA). Dec 1979.

From Mechanical and mag. energy storage contractor review meeting; Washington, DC, USA (19 Aug 1979).

The Department of Energy, Division of Energy Storage Systems, has designated the Lawrence Livermore Laboratory (LLL) as the technical manager arm for conducting research in the area of mechanical energy storage. This paper describes developments regarding vehicular applications of that management effort. A five-year project plan, with supporting rationale, is presented.

EMISSION CONTROL

8830 (AD-A—071002) **Critical assessment of emissions from aircraft piston engines. Final report, June 1974-May 1978.** Mirsky, W.; Pace, R.; Ponsonby, R.; Nicholls, J.A.; Geister, D.E. (Michigan Univ., Ann Arbor (USA). Dept. of Aerospace Engineering). Jun 1979. Contract DOT-FA74NA-1102. 158p. NTIS PC A08/MF A01.

A comprehensive mathematical analysis for evaluating the measured emissions from piston type general aviation aircraft engines is presented and discussed. The analysis is used to calculate the fuel-air ratio, molecular weight of the exhaust products, and water correction factor. Further, a sensitivity analysis is presented which shows the effects of emission measurement errors on calculated fuel-air ratio. The University's test facility is briefly described and the associated emissions instrumentation is discussed in detail. The experimental results obtained in this facility on the AVCO-Lycoming LIO-320 engine are presented. This includes baseline and lean-out emissions data and the influence of sampling probe location in the exhaust pipe. The influence of leaks in the exhaust system or emissions console are investigated and evaluated in terms of the mathematical model. Experimental data obtained from various facilities are compared and evaluated.

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 8080, 8639

MATERIALS

REFER ALSO TO CITATION(S) 8003

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 8001, 8002, 8004, 8967

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 8487, 8617, 8838, 8841, 8847, 8856

8831 (BM-RI—8385) **Low-sulfur pressure vessel steels by the electroslag and electric-arc-furnace processes.** Nafziger, R.H.; Sanker, P.E. (Bureau of Mines, Albany, OR (USA). Albany Metallurgy Research Center). 1979. 38p. Bureau of Mines, Washington, DC.

Bureau of Mines research shows that very low-sulfur pressure vessel steels with improved mechanical properties can be prepared by two melting processes. Four pressure vessel steels having sulfur contents ranging from 0.0008 to 0.0040 wt %, were produced by the electric-arc furnace or by the electro-slag processes. Calcium carbide was used as a desulfurizer in the electric-arc furnace. Fluxes containing at least 40 wt % CaO provided sufficient desulfurization during electroslag remelting. Element recoveries were higher for electroslag remelting than for metal melted in the electric-arc furnace. Bar rolled from electroslag-remelted ingots generally possessed higher tensile strengths and ductility than bar rolled from ingots melted in the electric-arc furnace. Charpy V-Notch upper shelf energies were also improved as a result of electroslag remelting. The primary failure mode during impact testing was microvoid coalescence. Sulfide inclusions were minimal, especially in the electroslag-remelted material.

8832 (HEDL-SA—1939-FP) **Double fission chamber for absolute fission rate measurements in power reactor environments.** Fuller, J.L.; Gilliam, D.M.; Grundl, J.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1979. Contract EY-76-C-14-2170. 9p. (CONF-791051—15). Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

A prototype fission chamber was tested and several chambers were built. The design and performance characteristics are presented. (FS)

8833 (RFP—2925) **Segregation effects in JBK-75.** Mataya, M.C.; Edstrom, C.M.; Krenzer, R.W.; Doyle, J.H. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 21 Dec 1979. Contract EY-76-C-04-3533. 37p. Dep. NTIS, PC A03/MF A01.

Chemical segregation of alloying elements, can be a severe problem in complex alloys. Many problems have been experienced with developing fabrication processes for JBK-75 and it is suggested that these difficulties may be related in part to the degree of chemical heterogeneity that exists in the alloy. Early testing and qualification of the alloy was made on relatively homogeneous samples, which came from small diameter ingots. In large size ingots used for production, it is more difficult to achieve a uniform distribution of alloying elements in the product; resulting in greater variability of alloy properties which are difficult to explain. Extensive microprobe measurements were made on samples of JBK-75 bar stock from several different production size ingots. It was found that segregation of titanium is a common occurrence. Titanium banding can be controlled by ingot melting rate and homogenization of ingot or intermediate product. A model for titanium diffusion shows that homogenizing at the ingot stage is ineffectual with respect to the spacing measured. However, homogenizing 20.3-cm diameter intermediate product, where band spacing is reduced, will significantly reduce segregation. The effect of segregation on tensile properties is discussed. Segregation may have a significant influence on forgeability of JBK-75. Forgeability tests show that microstructure plays an important role in the ability of JBK-75 to deform homogeneously, and microstructure is controlled by chemical uniformity of the alloy. Inhomogeneous shear during forging can cause adiabatic shear planes to form, and these have been observed in JBK-75.

8834 (SAND—79-8068) **Causes of weld porosity in electroformed nickel.** Brooks, J.A.; Dini, J.W.; Johnson, H.R. (Sandia Labs., Albuquerque, NM (USA)). Dec 1979. Contract EY-76-C-04-0789. 16p. Dep. NTIS, PC A02/MF A01.

Information provided by thermogravimetric analysis was coupled with studies of gas tungsten arc welds to determine the causes of weld porosity in electroformed nickel. When both C and O did not exceed ~ 40 ppM and N was ~ 80 ppM or less in the deposit, no porosity was observed following welding. Increasing the C and O to 60 to 70 ppM and N to 100 ppM resulted in significant porosity in welded samples. Thermogravimetric analysis indicated that the porosity could result from N_2 and/or C plus O combining to form CO and CO_2. There were also indications that SO_2 contributed to the porosity.

8835 (WAPD-TM—1428) **Temperature and distortion transients in gas tungsten-arc weldments.** Glickstein, S.S.; Friedman, E. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1979. Contract EY-76-C-11-0014. 64p. Dep. NTIS, PC A04/MF A01.

An analysis and test program to develop a fundamental understanding of the gas tungsten-arc welding process has been undertaken at the Bettis Atomic Power Laboratory to develop techniques to determine and control the various welding parameters and weldment conditions so as to result in optimum weld response characteristics. These response characteristics include depth of penetration, weld bead configuration, weld bead sink and roll, distortion, and cracking sensitivity. The results are documented of that part of the program devoted to analytical and experimental investigations of temperatures, weld bead dimensions, and distortions for moving gas tungsten-arc welds applied to Alloy 600 plates.

8836 **Solidification behavior of austenitic stainless steel filler metals.** David, S.A.; Goodwin, G.M.; Braski, D.N. (Oak Ridge National Lab., TN). *Weld. J. (Miami);* **58**: No. 11, 330s-336s(Nov 1979).

Thermal analysis and interrupted solidification experiments were conducted on selected austenitic stainless steel filler metals to gain an understanding of the solidification behavior of austenitic stainless steel welds. The following sequences of phase separations for the alloys investigated result: for Type 308 stainless steel filler metal, $L \rightarrow L + \delta \rightarrow L + \delta + \gamma \rightarrow \gamma + \delta$, and for Type 310 stainless steel filler metal, $L \rightarrow L + \gamma \rightarrow \gamma$. In Type 308 stainless steel filler metal, ferrite at room temperature was identified as either the untransformed primary δ-ferrite formed during the initial stages of solidification or the residual ferrite after Widmanstaetten austenite precipitation. Microprobe and scanning transmission electron microscope microanalyses revealed that solute extensively redistributes during the transformation of primary δ-ferrite to austenite, leading to enrichment and stabilization of ferrite by chromium. The Type 310 stainless steel filler metal investigated solidifies by the primary crystallization of austenite with the transformation going to completion at the solidus temperature. In samples residual ferrite resulting from solute segregation was absent at the intercellular or interdendritic regions.

8837 (RDT-M—2-19T(8-79)(Rev.)) **RDT Standard: 2-1/4%-chromium, 1%-molybdenum alloy steel tubesheet forgings (ASME SA-336 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 11p. RSO.

This standard covers 2-1/4%-chromium, 1%-molybdenum alloy steel forgings for heat exchanger and steam generator tubesheets for nuclear and associated applications. Material shall conform to the requirements of ASME SA-336, Grade F22A; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 8844, 8846, 8848, 9482

8838 (CONF-790801—6) **Superposition of alloy hardening, strain hardening, and dynamic recovery.** Kocks, U.F. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 22p. Dep. NTIS, PC A02/MF A01.

From 5. international conference on the strength of metals and alloys; Aachen, F.R. Germany (Aug 1979).

The principles and heuristics of flow stress superposition are illustrated for the case that one of the components is due to dislocation/dislocation interactions and is the only one that changes with strain. A simultaneous investigation of the flow stress and its rate sensitivity as a function of strain then allows one to confirm or refute postulated superposition laws and, in addition, to separate the effects of alloying or heat treatment on yield stress and on strain hardening. The slope of the observed stress strain curve depends on the form of the superposition law even if there is no physical influence of alloying on the dislocation storage rate; the frequently observed low initial strain hardening associated with a higher yield stress may in some cases be merely a consequence of a nonlinear superposition. At higher strains, the influence of alloying on dynamic recovery becomes the predominant effect; it also controls the high-temperature creep strength. When dynamic recovery plays an important role, it provides a further straining mechanism which, however, is not additive to the low-temperature strain rate; a form of the superposition law for long-range slip and this dynamic recovery strain is proposed. An application of these principles has demonstrated that dynamic strain aging is due to an effect of mobile solute atoms on the strain-hardening component of the flow stress, not on the friction stress.

8839 (SAND—79-8735) **Effect of nitrogen on stacking fault energy of Fe-Ni-Cr-Mn steels.** Stoltz, R.E.; VanderSande, J.B. (Sandia Labs., Livermore, CA (USA); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Dec 1979. Contract EY-76-C-04-0789. 23p. Dep. NTIS, PC A02/MF A01.

The effect of nitrogen content on stacking fault energy (SFE) has been measured in a series of Fe-21Cr-6Ni-9Mn alloys. Stacking fault energies were determined from node measurements using weak beam imaging techniques in transmission electron microscopy. Nitrogen additions lower the SFE from 53 MJ/m^2 at 0.21 wt % to ~ 33 MJ/m^2 at 0.24 wt %. Further increases to 0.52 wt % do not markedly change the SFE. Carbon and silicon had no effect on SFE in the ranges 0.010 to 0.060 wt % C and 0.17 to 0.25 wt % Si. The shift in SFE from 0.21 to 0.24 wt % N is accompanied by a transition to a more planar plastic deformation mode. The sharp transition precludes the use of linear regression analysis for relating SFE to nitrogen content in this class of alloys.

8840 **Computer simulation of the carbon diffusivity in austenite.** Murch, G.E.; Thorn, R.J. (Argonne Natl Lab, Ill). *J. Phys. Chem. Solids;* **40**: No. 5, 389-391(1979).

Tracer carbon diffusion in austenite is formulated in terms of a f.c.c. lattice gas model in which carbon interstitials repel at the distance of nearest neighbors. A Monte Carlo method is used to calcualte the tracer carbon diffusivity as a function of composition and interaction energy. The computed diffusivities are discussed in relation to the experimentally determined diffusivities and the results of a model investigated by D.C. Parris and R.B. McLellan.

8841 (ANL-Trans—1183) **Isothermal section of the ternary system praseodymium-nickel-aluminum at 800°C in the region of 0-33.3 at. % of praseodymium.** Rikhal, R.M.; Zaerchnyuk, O.S.; Kuten, Ya.I. Translated from *Dopov. Akad. Nauk Ukr. RSR, Ser. A: Fiz.-Tekh. Mat. Nauki;* No. 12, 1136-1138(1978). 6p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Results are presented concerning phase composition of alloys and the crystalline structures of Pr-Ni-Al in the region of praseodymium content up to 33.3 at. % at 800°C. (FS)

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 8312, 8483, 8528, 8831, 8833, 8837, 8839, 8868, 8873

8842 (HEDL-SA—1809) **Specimen size-considerations in fatigue crack growth rate testing.** James, L.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1979. Contract EY-76-C-14-2170. 17p. (CONF-7910102—1). Dep. NTIS, PC A02/MF A01.

From ASTM symposium on fatigue crack growth measurement and data analysis; Pittsburgh, PA, USA (29 Oct 1979).

The effect of specimen size upon the fatigue-crack growth behavior of annealed AISI Type 304 stainless steel was studied at two stress ratios at an elevated temperature. The resulting data were examined in the light of the present ASTM size criterion (based upon monotonic yield stength) as well as a proposed criterion based upon the material flow strength. The flow stress criterion is considerably less restrictive than the present ASTM Criterion, and the results of this study indicate that the flow stress criterion is entirely appropriate for strain-hardening materials such as the austenitic stainless steels.

8843 (HEDL-SA—1810) **Evaluation of the round compact specimen for fatigue-crack growth rate testing.** James, L.A.; Mills, W.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1979. Contract EY-76-C-14-2170. 18p. (CONF-7910102—2). Dep. NTIS, PC A02/MF A01.

From ASTM symposium on fatigue crack growth measurement and data analysis; Pittsburgh, PA, USA (29 Oct 1979).

A proposed round compact specimen was evaluated for its suitability for fatigue-crack growth rate testing. The results were compared to results from standard compact specimens (per ASTM E647-78T), and the two specimens were found to yield equivalent results. A number of K-solution have also been proposed for the round compact specimens, and these are reviewed. The agreement between the various solutions was quite good, and the Newman Equation was used to evaluate the present results.

8844 (HEDL-TME—79-10) **Room temperature and elevated temperature deformation characteristics of inconel X-750.** Mills, W.J.; Mastel, B. (Hanford Engineering Development Lab., Richland, WA (USA)). Nov 1979. Contract EY-76-C-14-2170. 32p. Dep. NTIS, PC A03/MF A01.

Thin foil electron microscopy techniques were used to characterize the dislocation behavior of Inconel X-750 tensile specimens tested at temperatures ranging from room temperature of 1500°F (816°C). Operative dislocation mechanisms were related to the fracture surface morphologies and the overall tensile response of this nickel-base alloy. Under room temperature and intermediate temperature conditions, a rather extensive dislocation substructure throughout the matrix was associated with the ductile response exhibited by Inconel X-750. In the higher temperature regime, approximately 1200 to 1300°F (649 to 704°C), all dislocation activity was channeled through narrow slip bands which subsequently initiated localized separation and a very faceted fracture surface appearance. The absence of a homogeneous dislocation substructure in this temperature regime resulted in a severe degradation in ductility levels. At the highest test temperature, 1500°F (816°C), a uniform dislocation network throughout the Inconel X-750 matrix coupled with intense dislocation activity adjacent to the grain boundaries resulted in a marked improvement in ductility.

8845 (K/CSD/TM—30) **Implicit strain-hardening formulation for creep analysis.** Bass, B.R.; Johnson, W.G.; McGrath, S.V. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). May 1979. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

A variable stiffness method for creep analysis is presented that utilizes a strain-hardening theory of creep and an implicit time-marching scheme. The formulation makes use of the change in stress and accumulated creep strain during a time interval to determine the corresponding creep strain increment. The method is well suited for use in formulations of elastic-plastic-creep and large displacement, small strain analysis. Applications are presented to demonstrate that this implicit method offers numerical stability using relatively large time steps for which the conventional explicit scheme fails to function.

8846 (STU—75-3741, pp 22 p.) **Characterization of the material used in the project 'stress corrosion cracking in austenitic material for nuclear power reactors'. CNIITMASH/STU.** Rosborg, B. Nov 1978.

In Testing in a 100 ppm Cl and 0.2 ppm O_2 sodium chloride solution at 320 deg C.

In the cooperation project "Stress Corrosion Cracking in austenitic material for nuclear power reactors" are CNIITMASH (Russia), Atomic energy (Studsvik) Sandvik AB and the Swedish Board for Technical Development involved. For the material used in the project, which is produced by Sandvik AB, has a characterization been made. The material consists of variants of SANDVIK San 70, SANDVIK San 30, SANDVIK 8R30 and 20Cr-25Ni. The following properties have been studied: Mechanical properties (at room temp. 150 deg C, 200 deg C, 350 deg C) grain sizes, chemical composition and hardness (HV 30).

8847 (UCID—18179) **Mechanical properties of cold-worked 5083 aluminum.** Prado, M.E.; Scott, J.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Mar 1979. Contract W-7405-ENG-48. 16p. Dep. NTIS, PC A02/MF A01.

Tensile and fracture-toughness tests of 25%-cold-worked 5083 aluminum and weld material were conducted. The tests showed that the aluminum is highly nonhomogeneous; its fracture toughness, elongation, and percent reduction in area varied greatly from point to point. This characteristic could significantly affect the design of 5083 applications. The weld material exhibited more uniform mechanical properties throughout the weld. However, its fracture toughness varied from 19 to 49 ksi.in./sup 1/2/. The weld-joint geometry affects the fracture characteristics of the joint.

8848 **Thermal recovery processes in deformed aluminum.** Hasewaga, T.; Kocks, U.F. (Argonne National Lab., IL). *Acta Metall.;* **27**: No. 11, 1705-1716(Nov 1979).

The effects of recovery on both microstructure and subsequent stress vs strain behavior were studied in pure aluminum single crystals prestrained at room temperature in <111> compression; they are presumed to be representative of polycrystal behavior, avoiding changes in grain structure. Transmission electron microscopy showed that two distinct dislocation processes occur: (1) a rapid tightening of tangles and loose cell walls, eventually into subgrain boundaries, without a noticeable change in the scale of the structure, and (2) subsequent coarsening of the subgrain structure. These two processes of microstructural change were correlated respectively with two distinct types (I and II) of stress vs strain behavior during postanneal straining. After Type I recovery, the relation between the strain-hardening rate, $\theta = d\sigma/d\epsilon$ (σ: true stress, ϵ: true strain), and the true stress is identical to that of an unrecovered specimen, after a transient of a few percent of postanneal straining. Type I recovery encompasses all of metarecovery and part of orthorecovery, and bears resemblance to dynamic recovery processes during stage III strain-hardening. Type II recovery, which succeeds Type I recovery, shows long-lasting effects on the mechanical behavior which are characterized in particular by unusually low θ values compared to unrecovered specimens deformed to the same stress. It may correspond to some transition stage between recovery and recrystallization.

8849 **Combining phenomenology and physics in describing the high temperature mechanical behavior of crystalline solids.** Sherby, O.D.; Miller, A.K. (Stanford Univ., CA). *J. Eng. Mater. Technol.;* **101**: No. 4, 387-395(Oct 1979).

It is now possible to predict quantitatively the high temperature mechanical behavior of pure metals, solid solution alloys and dispersion hardened alloys, based on an understanding of a number of physical factors influencing power law creep, including: (a) atom mobility by lattice diffusion and by dislocation pipe diffusion, (b) elastic constants of the matrix material, (c) subgrain size, (d) stacking fault energy, and (e) crystallographic texture. This quantitative picture can be extended and generalized to transient situations using the work hardening-recovery approach, and strengthening due to back stresses, solutes, and irradiation can be incorporated within the same framework. The resulting set of constitutive equations for creep rests on a firm physical foundation and yet can predict the high-temperature behavior of materials under the complex histories typical of technological applications. 72 references.

8850 **Application of corrosion fatigue crack growth rate data to integrity analyses of nuclear reactor vessels.** Bamford, W.H. (Westinghouse Nuclear Energy Systems, Pittsburgh, PA). *J. Eng. Mater. Technol.;* **101**: No. 3, 182-190(Jul 1979).

The methodology of fatigue crack growth analysis in evaluating structural integrity of nuclear components has been well established over the years, even to the point where a recommended practice has been incorporated in Appendix A to Section XI of the ASME Code. The present reference curve for crack growth rates of pressure vessel steels in reactor water environment was developed in 1973, and since that time a great deal of data have become available. The original curve was meant to be a bounding curve, and some recent data have exceeded it, so an important question to address is which reference curve to use for these calculations. The important features of fatigue crack growth behavior in a reactor water environment are reviewed, along with some suggested explanation for the observed environmental enhancement and overall trends. The variables which must be accounted for in any reference crack growth rate curve are delineated and various methods for accomplishing this task are discussed. Improvements to the present reference curve are suggested, and evaluated as to their accuracy relative to the present curve. The impact of the alternative curves is also evaluated through solution of an example problem. A discussion of the conservatisms included in the alternative reference curves as compared with the present reference curve is included. Also research work is identified which could lead to further improvement in the reference curves.

8851 **Fatigue crack growth behavior of four structural alloys in high temperature, high purity oxygenated water.** Hale, D.A.; Jewett, C.W.; Kass, J.N. (General Electric Co., San Jose, CA). *J. Eng. Mater. Technol.;* **101**: No. 3, 191-198(Jul 1979).

The fatigue crack growth behavior of four structural alloys was studied and the effects of high temperature (288°C), high purity

oxygenated water, cycle frequency, and mean stress were evaluated. The results for carbon and low alloy steel show that while crack growth rates are affected by the water environment, modified ASME code procedures result in conservative predictions of growth. Often, higher crack growth rates are found for shallow cracks than for deep cracks. For stainless steels and Inconel the measured growth rates in water were similar to data obtained in air over the range of cycle frequencies studied.

8852 Fatigue crack growth in 2 1/4Cr-1Mo steel exposed to hydrogen containing gases. Brazill, R.; Simmons, G.W.; Wei, R.P. (Lehigh Univ., Bethlehem, PA). Contract EX-76-S-01-2527. *J. Eng. Mater. Technol.;* **101**: No. 3, 199-204(Jul 1979).

Steels used in coal gasification vessels and piping (externals) can be exposed to mixtures of hydrogen, water vapor (steam), hydrogen sulfide, methane, carbon monoxide, carbon dioxide, and other gases at temperatures and pressures up to 600°K and 10 MPa. Such mixtures, under certain operating conditions, can either enhance or inhibit crack growth in these steels. As a part of a program to identify thermodynamic conditions for this enhancement or inhibition, fatigue crack growth experiments have been carried out on a 2 1/4Cr-1Mo (ASTM A542, Class 2) steel in hydrogen, water vapor, and hydrogen sulfide at low pressures (below 133 kPa). The results indicate considerable enhancement of fatigue crack growth by some of these environments and also indicate that the apparent immunity of this material to stress corrosion cracking does not imply the same immunity to corrosion fatigue. The results will be discussed in terms of the influences of temperature, gas pressure and loading variables, and will be interpreted in terms of chemical reaction kinetics.

8853 Fatigue-crack propagation response of two nickel-base alloys in a liquid sodium environment. Mills, W.J.; James, L.A. (HAnford Engineering Development Lab., Richland, WA). Contract EY-76-C-14-2170. *J. Eng. Mater. Technol.;* **101**: No. 3, 205-213(Jul 1979).

The elevated temperature fatigue-crack propagation response of Inconel 600 and Inconel 718 was characterized within a linear-elastic fracture mechanics framework in air and low-oxygen liquid soium environments. The crack growth rates of both nickel-base alloys tested in liquid sodium were found to be considerably lower than those obtained in air. This enhanced fatigue resistance in sodium was attributed to the very low oxygen content in the inert sodium environment. Electron fractographic examination of the Inconel 600 and Inconel 718 fatigue fracture surfaces revealed that operative crack growth mechanisms were dependent on the prevailing stress intensity level. Under low growth rate conditions, Inconel 600 and Inconel 718 fracture surfaces exhibited a faceted, crystallographic morphology in both air and sodium environments. In the higher growth rate regime, fatigue striations were observed; however, striations formed in sodium were rather ill-defined. These indistinct striations were attributed to the absence of oxygen in the liquid sodium environment. Striation spacing measurements were found to be in excellent agreement with macroscopic growth rates in both environments.

8854 Fatigue crack growth behavior of stainless steel Type 316 plate and 16-8-2 weldments in air and high-carbon liquid sodium. Yuen, J.L.; Copeland, J.F. (General Electric Co., San Jose, CA). Contract EY-76-C-03-0893. *J. Eng. Mater. Technol.;* **101**: No. 3, 214-223(Jul 1979).

The fatigue crack growth rates of Type 316 stainless steel and 16-8-2 gas tungsten arc welds were measured in air and high-carbon liquid sodium at 510°C (950°F) for secondary sodium loop Liquid Metal Fast Breeder Reactor applications. Loading variables such as low frequency, load ratio, and hold time at peak load were studied. Supporting studies show that carburization of crack faces occurs prior to any crack tip carburization for the crack sizes and load frequencies of this study. Thus, a carburization effect on da/dN is not shown for relatively short-term tests. Low stress intensity, ultra-low frequency tests to simulate service would be required to show this effect. The crack growth rate curve for 16-8-2 welds was below Type 316 base metal curves for both air and hig-carbon sodium at 510°C (950°F). Crack growth rate curves for Type 316 and 16-8-2 welds in high-carbon sodium were below the corresponding curves for air.

8855 Analysis of the rupture behavior of pressurized fast reactor cladding tubes subjected to thermal transients. Kramer, J.M.; DiMelfi, R.J. (Argonne National Lab., IL). *J. Eng. Mater. Technol.;* **101**: No. 3, 293-298(Jul 1979).

The rupture behavior of 20% cold-worked Type 316 stainless steel fast reactor fuel cladding, subjected to thermal transients typical of hypothetical accident conditions, is studied by considering the response of a thin-walled cylinder loaded by constant internal pressure. The high-stress low-temperature failure behavior is analyzed using a correlation from low temperature tensile properties. The low-stress high-temperature regime is shown to be described by a combined creep-deformation crack-growth-law formulation including annealing effects via grain growth. Failure temperatures and failure ductilities calculated using these models, compare favorably with experiment. It is also shown how the models can be extended to explain the observed reduction in failure temperature and failure ductility of cladding tubes that have been exposed to irradiation and/or corrosive environments.

8856 (M—342E) Martensitic cast steels with high impact strength at low temperatures. Gysel, W.; Gerber, E. Translated from *Konstr. Giessen;* No. 2, 17-25(Feb 1978). 12p. Climax Molybdenum Co., One Greenwich Plaza, Greenwich, CT 06830.

Martensitic chromium steel castings, if carefully melted, deoxidized and heat treated, are characterized by excellent low temperature toughness in the core portion of thick walled castings with a simple air hardening and tempering. The somewhat higher alloying costs compared to the low alloy nickel steels are partly compensated for by the improved machinability. The most important critera, minimum temperature for impact (ISO-V sample) value of 27 J, minimum temperature for lateral expansion of 0.4 mm, and FATT can be guaranteed.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 8754, 8759, 8879, 9511

8857 Relation between the activation energy for self diffusion and the partial molar energy in interstitial solid solutions. Murch, G.E. (Argonne National Lab., IL). *Acta Metall.;* **27**: No. 11, 1701-1704(Nov 1979).

Within the framework of the lattice gas as a model for the thermodynamic and transport properties in interstitial solid solutions, an approximate relationship between the partial molar energy and the activation energy for solute diffusion is indicated. As an example of the relation, an application is made to austenite. It is found that the compositional dependence of the tracer carbon diffusion coefficient is reasonably well represented using the partial molar enthalpy of carbon as input to the equation for the tracer diffusion coefficient.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 8008, 8026, 8211, 8212, 8213, 8214, 8215, 8312, 8850

8858 (CONF-7910110—1) Effect of sulfation accelerators on the corrosion behavior of materials in fluidized-bed environments. Chopra, O.K.; Shearer, J.A.; Turner, C.B. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 17p. Dep. NTIS, PC A02/MF A01.

From TMS-AIME fall meeting on corrosion-erosion behavior of materials; St. Louis, MO, USA (16 Oct 1979).

Enhancement of limestone sulfation in a fluidized-bed combustion environment by the addition of accelerators, such as NaCl and $CaCl_2$, can greatly reduce the quantity of limestone needed to achieve acceptable SO_2 emission levels. However, the presence of alkali-metal compounds in the fluidized bed could contribute to corrosion of structural materials in the boiler and downstream components. In the present study, the corrosion behavior of various iron- and nickel-base alloys is evaluated as functions of temperature and chloride content in the bed. Corrosion specimens were exposed for 100 h within and above a fluidized bed of limestone. The fluidizing gas contained SO_2, O_2, and N_2. Under the test conditions, the addition of NaCl and $CaCl_2$ to the fluidized bed increased the corrosion rates. In general, the austenitic iron-base materials performed better than nickel-base superalloys. The results of detailed metallographic examination of the corrosion specimens are presented.

8859 (DOE/NASA/2593—79/12) Effect of sodium, potassium, magnesium, calcium, and chlorine on the high temperature corrosion of IN-100, U-700, IN-792, and Mar M-509. Lowell, C.E.; Sidik, S.M.; Deadmore, D.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. Contract EF-77-A-01-2593. 29p. (NASA-TM—79309). Dep. NTIS, PC A03/MF A01.

If coal-derived liquids are to be used as fuel for power turbines, effects of trace elements on the accelerated corrosion of the turbine must be evaluated. Effects of Na, K, Ca, Mg, and Cl were studied in jet-fuel burner rig on three Ni-base alloys (IN-100, U-700, IN-792) and one Co-base alloy (Mar M-509). An attack model was developed which seems to account for most of the important first-order effects. (DLC)

8860 (INKA-Conf—79-042-000(Vol.2)) Hydrogen in metals. (Muenster Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie). 1979. 444p. (CONF-790301—(Vol.2); INKA-Conf—79-042-054; INKA-Conf—79-042-059). Dep. NTIS (US Sales Only), PC A19/MF A01.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

Preprints of 38 papers are inluded in this volume. Eleven of these papers are indexed separately.

8861 (INKA-Conf—79-042-000(Vol.2), pp 425-438) **Thermodynamic relationships and structural transformations in TiCo & TiNi intermetallic alloy + hydrogen systems.** Burch, R.; Mason, N.B. (Univ., Whiteknights, Reading, England). 1979.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

Pressure-composition isotherms and thermodyamic data have been determined for the TiCo + H and TiNi + H systems. The TiCo + H system exhibits a series of plateaus corresponding to the coexistence of two solid phases. The isotherms in TiNi + H do not contain plateaus. The enthalpy and entropy data are consistent with a model in which the hydrogen only occupies tetrahedral interstitial sites in the body-centered-cubic metals at very low hydrogen contents. It is suggested that there is a transformation from tetrahedral sites to octahedral sites as the hydrogen content increases. In the TiNi + H system it has been observed that there is a very sluggish approach to equilibrium in the temperature range 300 to 450K. Furthermore, both in TiNi and in Ti_2Ni, temperature programmed decomposition experiments show an anomalous solubility effect above 600 to 700K. As the temperature is increased from 300K there is the normal desorption of hydrogen, but at 600 to 700K hydrogen is reabsorbed. This process continues up to 850K at which point a second reversal is observed and hydrogen desorbs again. Structural transformations which are consistent with these effects are discussed.

8862 (INKA-Conf—79-042-000(Vol.2), pp 519-530) **Theoretical study of the trapping and mobility of hydrogen near vacancies, dislocations, and cracks in nickel.** Baskes, M.I.; Melius, C.F. (Sandia Labs., Livermore, CA). 1979.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

The behavior of a hydrogen atom in the vicinity of various lattice defects (point defects, dislocations, and crack-induced stress fields) in nickel has been studied theoretically. The trapping energies and migration energies are calculated using an extension of the atomistic lattice defect method which includes the quantum chemical effect of the hydrogen with the lattice electrons, lattice atom relaxation due to the hydrogen, as well as a coupling of the lattice atoms to the surrounding continuum. The results indicate that a hydrogen atom interacts weakly with these lattice defects. Calculated binding energies of a hydrogen atom to a vacancy, a dislocation, and a stress field are less than 0.1 eV. The activation energy for diffusion along the dislocation (pipe diffusion) does not appear to be significantly different from the 0.4 eV for bulk diffusion. Contour plots of the solubility and diffusivity of hydrogen in the stressed region surrounding the crack tip are presented.

8863 (INKA-Conf—79-042-000(Vol.2), pp 624-634) **Catalytic role of Mg_2Cu in the hydriding and dehydriding of Mg.** Genossar, J.; Rudman, P.S. (Technion-Israel Inst. of Tech., Haifa). 1979.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

The eutectic alloy Mg/Mg_2Cu was studied at H_2 pressure such that only the Mg phase hydrided and the Mg_2Cu phase had a catalyzer role only. This alloy was chosen as a convenient model system: a two phase alloy with one phase a catalyzer and the second a hydride former. From the t,T,P behavior of the hydriding/dehydriding kinetics it is concluded that hydriding is rate-limited by the diffusion of H through a growing MgH_2 layer; dehydriding by the diffusion of H through a growing Mg layer. These slow, intrinsic kinetics are shown to be primarily due to small concentration gradients because of limited solubility rather than to small diffusivities. It is concluded that the catalytic role of the Mg_2Cu phase is the providing of an unoxidized external surface because its oxides are reduced by the H_2. It is speculated that an additional catalytic role may be the providing of an unhydrided external surface. This catalytic mechanism is generalized to explain the activation process in the alloys Mg_2Ni, TiFe and $LaNi_5$.

8864 (INKA-Conf—79-042-000(Vol.2), pp 674-683) **Factors affecting the absorption of hydrogen by Zircaloys.** Darby, M.I.; Read, M.R.; Taylor, K.N.R. (Univ. of New South Wales, Kensington, Australia). 1979.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

A proton model has been employed to calculate how the elements Sn, Fe, Cr, and Ni in Zircaloys affect the absorption of hydrogen compared with in zirconium. It is found that Fe, Cr, and Ni reduce the absorption of hydrogen by almost equal amounts per atom added, whereas Sn has little or no affect on the absorption.

8865 **Method for inhibiting corrosion in aqueous systems.** DeMonbrun, J.R.; Schmitt, C.R.; Schreyer, J.M. (to Dept. of Energy). US Patent Application 960,982. 15 Nov 1978. 9p.

A method for inhibiting corrosion is aqueous systems containing components composed of aluminum, copper, iron, or alloys is described. The method consists of incorporating in the aqueous medium 2-10 ppm by weight of tolytriazole; an effective amount of a biodegradable organic biocide; 500-1000 ppm by weight of sodium metasilicate; 500-2000 ppm by weight of sodim metasilicate; 500-2000 ppm by weight of sodium nitrite; and 500-2000 ppm by weight of sodium tetraborate. All of these concentrations being based on the weitght of water in the system; and maintaining the pH of the resulting system in the range of 7.5 to 8.0. The method permits longterm operation with very low corrosion rates and bacteria counts. All of the additives to the system are biodegradable, permitting the treated aqueous medium to be discharged to the environment without violating current regulations. The method has several application to solar systems in which an aqueous medium is circulated through aluminum-alloy heat exchangers.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 8521

8866 (HEDL-SA—1949) **LWR-PV Surveillance Dosimetry Improvement Program review graphics.** McElroy, W.N.; Gold, R.; Gutherie, G.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1979. Contract EY-76-C-14-2170. 57p. (CONF-791118—5). Dep. NTIS, PC A04/MF A01.

From 7. water reactor safety research information meeting; Gaithersburg, MD, USA (5 Nov 1979).

A primary objective of the multilaboratory program is to prepare an updated and improved set of dosimetry, damage correlation, and the associated reactor analysis ASTM standards for LWR-PV irradiation surveillance programs. Supporting this objective are a series of analytical and experimental validation and calibration studies in Benchmark Neutron Fields, reactor Test Regions, and operating power reactor Surveillance Positions. These studies will establish and certify the precision and accuracy of the measurement and predictive methods which are recommended for use in these standards. Consistent and accurate measurement and data analysis techniques and methods, therefore, will have been developed and validated along with guidelines for required neutron field calculations that are used to (1) correlate changes in material properties with the characteristics of the neutron radiation field and (2) predict pressure vessel steel toughness and embrittlement from power reactor surveillance data.

8867 (HEDL-SA—1983) **Seminar on fast reactor cladding materials.** (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 187p. (CONF-791120—). AT.

From Seminar on fast reactor cladding materials; Richland, WA, USA (12 Nov 1979).

Separate abstracts have been prepared for the papers reprinted from this seminar. (FS)

8868 (HEDL-SA—1983, pp 1-19) **Reactor design implications of irradiation creep and swelling data.** Boltax, A. 1979.

From Seminar on fast reactor cladding materials; Richland, WA, USA (12 Nov 1979).

An assessment is presented of irradiation creep and swelling relative to various design applications and to illustrate the sensitivity of uncertainties in the available data when applied to design calculations where irradiation creep and swelling act in opposition.

8869 (HEDL-SA—1983, pp 20-40) **EBR-II and FFTF irradiation experiments.** Gilbert, E.R.; Paxton, M.M. 1979.

From Seminar on fast reactor cladding materials; Richland, WA, USA (12 Nov 1979).

Structural materials experiments were conducted in EBR-II using several different types of capsules. Subcapsule containing specimens were immersed in static sodium. The subcapsules are insulated from the outer capsule by a gas annulus which determines the irradiation temperature. A second type of noninstrumented capsule utilizes heat pipes for high temperature tests (650 to 750°C) where temperature fluctuations must be minimized. These heat pipes provide compensatory control to minimize effects of power fluctuation on temperature. In addition, instrumented vehicles using thermocouples and temperature controllers have been used for high temperature creep tests requiring accurate temperature measurement. These experimental methods were used to investigate the effects of temperature, temperature change, stress, and fluence dependence of in-reactor creep. Special tests have also yielded data on the effects of stress on swelling.

8870 (HEDL-SA—1983, pp 41-61) **Swelling behavior of AISI 316 stainless steel and advanced cladding alloys.** Korenko, M.K. (Hanford Engineering Development Lab., Richland, WA). 1979.

From Seminar on fast reactor cladding materials; Richland, WA, USA (12 Nov 1979).

Swelling response and microstructural development of materials which encompass the candidate duct and cladding alloys are discussed. The largest data base has been obtained on the solid

solution strengthened alloys which include AISI 316 stainless steel. Neutron irradiation of 316 steel to a peak fluence of 9 x 10^{22} n/cm^2 (E > 0.1 MeV) over the 400 to 650°C temperature range indicates that swelling in excess of 6% can be expected. Data illustrate the importance of controlled composition to reduce design uncertainties in swelling behavior. Composition dependence of swelling in the solid solution alloy class is illustrated with neutron irradiation data on Ni-Al and Fe-Ni-Cr alloys. Behavior is compared to the effect of silicon variations on swelling and irradiation creep in more complex 316 stainless steel alloys. Mechanisms responsible for these composition effects are related to the temperature and fluence dependence of microchemical and microstructural evolution. Behavior of the precipitation strengthened alloy class is represented by the response of Nimonic PE16 and Inconel 706 to neutron irradiation to peak fluences of 5 x 10^{22} n/cm^2 (E > 0.1 MeV). Both materials are more swelling resistant than AISI 316; however, data response indicates that the γ'/γ'' strengthened Incoloy 706 is the most swelling resistant. Swelling is a strong function of prior thermomechanical treatment. Ferritic alloys are represented by the martensitic material designated HT-9. Irradiation data indicate that these materials are extremely swelling resistant.

8871 (HEDL-SA—1983, pp 62-76) **Microstructural observations of AISI 316 stainless steel from high burnup fuel pins.** Brager, H.R.; Berting, F.M.; Garner, F.A. 1979.

From Seminar on fast reactor cladding materials; Richland, WA, USA (12 Nov 1979).

Microstructural data were obtained from three fuel pins clad with 20% cold worked drawn tubing made from 316 stainless steel. The cladding was irradiated at a temperature in the range 370 to 600°C to a peak neutron fluence of 10 x 10^{22} n/cm^2 (E > 0.1 MeV) in the EBR-II. Additionally, cladding from a fuel pin utilizing a steel identical to that used to clad FFTF first core fuel pins was examined after irradiation at comparable temperatures to a peak neutron fluence of 6 x 10^{22} n/cm^2 (E > 0.1 MeV). The microstructure from the mid-wall regions of the cladding specimens has been compared with that from specimens made from the same tubing but irradiated in non-fueled experiments. The comparison shows that the microstructural development is not significantly influenced by the presence of the fuel but rather is dependent on irradiation temperature and neutron fluence. The microstructure of the fuel pin cladding shows that void nucleation and growth and that Frank loop nucleation are temperature dependent. The microstructures support the concept of an interaction model for unfaulting of Frank loops, exhibit a temperature-independent saturation density of dislocation networks, and illustrate that void nucleation occurs heterogeneously. It would appear that nucleation of voids and swelling rate increases are associated with the emergence of nickel-rich precipitate phases including γ' (Ni_3Si).Type 316 stainless steel under irradiation tends to evolve towards a final saturation microstructure in which dislocation and Frank loop concentrations are independent of the starting microstructure.

8872 (HEDL-SA—1983, pp 77-101) **In-reactor creep of AISI 316 stainless steel and advanced cladding alloys.** Chin, B.A.; Gilbert, E.R. 1979.

From Seminar on fast reactor cladding materials; Richland, WA, USA (12 Nov 1979).

Tailored materials for FBR type reactor use are described. These materials have great resistance to in-reactor creep and swelling. The materials included are HT-9, SS types 310, 316, and 330, Ti modified 316, A-286, M-813, Nimonic PE16, and Inconels 706 and 718. (FS)

8873 (HEDL-SA—1983, pp 102-131) **Postirradiation mechanical properties of 20% CW AISI 316 stainless steel and the fuel adjacency effect.** Hunter, C.W.; Johnson, G.D.; Fish, R.L. 1979.

From Seminar on fast reactor cladding materials; Richland, WA, USA (12 Nov 1979).

The effects of fast reactor irradiation on the tensile properties were determined on tubing specimens irradiated at 540° and 590°C to a fluence of about 5 x 10^{22} n/cm^2 and at 370° and 650°C to a fluence of 8.4 x 10^{22} n/cm^2 (E > 0.1 MeV). For specimens irradiated and tested near the same temperature at a strain rate of 5 x 10^{-5}/s, the strength decreased with increasing temperature. Thermal annealing (softening) effects were observed at irradiation temperatures of 540°C and above; in fact, strength levels measured at 540°, 590°, and 650°C were essentially identical to those observed on 20% CW AISI 316 tubing aged out-of-reactor. Irradiation defect hardening was observed on the specimens irradiated at 370°C. The strength parameters became fluence independent at the higher fluences. The uniform and total elongation decreased continually at fluences above 2 x 10^{22} n/cm^2. However, at low temperatures (< 540°C), the ductility did not decrease beyond a fluence of 4 x 10^{22} n/cm^2.

8874 (HEDL-SA—1983, pp 132-155) **Charged particle irradiations in the United States Breeder Reactor Program.** Rowcliffe, A.F. (Oak Ridge National Lab., TN). 1979.

From Seminar on fast reactor cladding materials; Richland, WA, USA (12 Nov 1979).

Charged particle irradiations are widely used to study displacement damage effects in metals and alloys. In the Breeder Reactor Program the results of these studies are compared with in-reactor behavior. Charged particle irradiation differs in the proximity of surfaces, dose rate effects, stress state, nonuniform damage, recoil spectra, injected interstitial effect, and He injection. (FS)

8875 (HEDL-SA—1983, pp 156-168) **Swelling of OX16H15M3B steel under electron irradiation.** Yang, W.J.S. (Hanford Engineering Development Lab., Richland, WA). 1979.

From Seminar on fast reactor cladding materials; Richland, WA, USA (12 Nov 1979).

The temperature dependence of void swelling of USSR steel (OX16H15M3B) was studied by means of electron irradiation in a 1 MeV electron microscope. The irradiations were performed up to a total atomic displacement level of 31 dpa/sub e/ at 50°C intervals in the temperature range of 450 to 700°C. The temperature dependency of the swelling rate was found to be similar for both vacuum annealed and 15% CW tubing specimens. In the range of 450 to 550°C the swelling rate increased only moderately with increasing irradiation temperature, between 550 and 600°C it increased rapidly and at irradiation temperatures above 600°C it leveled off. In general, the void size increased with an increase in both irradiation temperature and irradiation dose. The void density decreased with both irradiation dose and irradiation temperature except in the temperature range of 550 to 600°C, where the void density increased with increasing irradiation temperature. These results are in agreement with the electron irradiation results on US N-lot steel (87210).

8876 (HEDL-SA—1983, pp 169-186) **Creep behavior of OX16H15M3B steel and comparison with AISI 316.** Gilbert, E.R.; Chin, B.A. (Hanford Engineering Development Lab., Richland, WA). 1979.

From Seminar on fast reactor cladding materials; Richland, WA, USA (12 Nov 1979).

Pressurized tube creep specimens were manufactured from OX16H15M3B tubing supplied by the USSR. These specimens are currently being irradiated in Experimental Breeder Reactor II (EBR-II). Four specimens (0, 33, 66 and 132 MPa) are being irradiated at 425°C in Capsule B-217b of the AA-IIa experiment while five specimens (0, 7.5, 18.9, 32 and 64 MPa) are being irradiated at 650°C in Capsule B-279a of the AA-IId experiment. The 650°C specimens were discharged from the reactor after EBR-II Run 99 at a fast fluence (E > 0.1 MeV) of 4.2 x 10^{22} n/cm^2. These specimens were measured and re-encapsulated for reirradiation beginning with Run 10 (May 1979). The 425°C specimens were discharged after EBR-II Run 100 at a fast fluence (E > 0.1 MeV) of 2.8 x 10^{22} n/cm^2. These specimens were measured and re-encapsulated for reirradiation which began in Run 102 (July 1979). This paper reviews the results of the measurements and compares them with creep data generated in the BOR-60 fast reactor on hexagonal channels and US design equations developed from results on AISI 316 pressurized tube specimens.

8877 (SAN—0034/172-1) **High temperature irradiation damage in nickel-chromium solid solutions.** Pinizzotto, R.F. Jr. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Aug 1978. Contract EY-76-S-03-0034-172. 227p. (UCLA—34P172-26). Dep. NTIS, PC A11/MF A01.

Metals have been observed to swell, i.e., increase in volume when exposed to large fluxes of energetic particles at high temperatures. The swelling behavior of pure metals and commercial alloys is generally well characterized, but data on swelling in binary alloys are rare. The results presented in this report are among the first in-depth studies of void swelling as a function of solute content. Pure Ni and Ni-Cr solid solutions containing up to 16% Cr were irradiated using heavy charged particles to simulate the radiation damage caused by neutron bombardment. Experiments were performed using either $^{14}N_2^+$ or $^{58}Ni^+$, accelerated to energies of 0.4 MeV (nitrogen ions) or 3.0 MeV and 3.5 MeV for nickel ions. Samples were irradiated between 500 and 700°C, which correspond to 0.4 to 0.6 of the melting points of these materials. The specimens were exposed to a maximum damage level of 20 dpa, calculated using the computer code of Manning and Mueller. The irradiation induced microstructures were characterized. The main components of the microstructure are a great number of voids that cause macroscopic volume increases and a dislocation distribution consisting of perfect dislocations and faulted dislocation loops. The parameters chosen to characterize these features are the void volume fraction, the mean void diameter, the void number density, and the dislocation density. The variations of the microstructural parameters were examined as functions of the Cr content, the irradiation temperature, the total irradiation dose, the type of incident ion and the sample configuration (i.e., electron transparent foils or bulk samples).

8878 **Defect-solute interactions and radiation-induced segregation in Ni(Si) and Ni(Ge) alloys.** Gupta, R.P.; Lam, N.Q. (Centre

d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). *Scr. Metall.;* **13**: No. 11, 1005-1010(Nov 1979).

The electronic structure of a solute is shown to play an important role in dictating the nature of its interactions with vacancies and interstitials in a solid. Contrary to usual expectations, the solute-vacancy binding energies are relatively large in Ni(Si) and Ni(Ge) systems. This indicates that, aside from the contribution of mixed dumbbells, the formation and migration of mobile vacancy-solute complexes can give rise to solute enrichment at sinks in these alloys. Calculations show that the defect-solute binding energies account for the segregation and precipitation behavior observed in Ni(Si) and Ni(Ge). (FS)

8879 **Recovery of tritium from lithium-sintered aluminium product (SAP) and lithium-aluminium alloys.** Talbot, J.B.; Wiffen, F.W. (Oak Ridge National Lab., TN (USA)). *J. Inorg. Nucl. Chem.;* **41**: No. 4, 439-444(1979).

The tritium release rates of irradiated samples of lithium-containing aluminium (Li-Al) and sintered aluminium product (Li-SAP) were investigated to evaluate the potential application of both materials in fusion reactors. The observed release rates followed the pattern expected for bulk diffusion of tritium in a solid. Therefore, diffusion coefficients for tritium in Li-SAP were determined over a temperature range of 383 and 500°C and tritium in Li-Al at 450°C. At 450°C, the diffusion coefficients of tritium in Li-SAP and Li-Al are 2.988 x 10^{-10} cm^2 sec^{-1} and 1.462 x 10^{-8} cm^2 sec^{-1}, respectively.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 8025

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 8137, 8616, 8885

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 8885

8880 (CONF-790682—6) **Quantitative image analysis of microstructure development during pressure sintering of CoO.** Miro, A.; Notis, M.R. (Lehigh Univ., Bethlehem, PA (USA)). 1979. Contract EY-76-S-02-2408. 13p. Dep. NTIS, PC A02/MF A01.

From 5. international conference on sintering and related phenomena; Notre Dame, IN, USA (18 Jun 1979).

An automatic system for quantitative image analysis was developed to study the transition from intermediate to final stage pore structure in pressure-sintered CoO. One of the significant results from this study indicates that the projected length is a good parameter to observe the transition from open cylindrical to closed porosity. Quantitative image analysis indicates that the Zener relationship (r/G ~ P) is obeyed through the entire sintering process.

8881 (INKA-Conf—79-042-000(Vol.2), pp 365-374) **Study of hydrogen diffusion in titanium hydride using nuclear magnetic resonance techniques.** Bustard, L.D. (Cornell Univ., Ithaca, NY); Cotts, R.M.; Seymour, E.F.W. 1979.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

In the γ-phase of TiH/sub x/, hydrogen atoms are known to occupy the tetrahedral interstitial sites which form a simple cubic sublattice in the FCC titanium host. To determine whether diffusing H atoms jump to nearest neighbor (NN) or third nearest neighbor (3NN) sites, NMR measurements of (1), the diffusion coefficients of H between 450°C and 550°C and (2), the hydrogen spin system longitudinal relaxation time, T/sub 1/, between 80°C and 550°C are presented for $TiH_{1.55}$ and $TiH_{1.71}$. From the relationship D = f/sub T/L^2 (6 tau/sub d/), the jump length, L, is determined from the measured diffusion coefficients, D, and values of the mean residence time between atomic hops, tau/sub d/, normally calculated from T/sub 1/ relaxation data. However, it is shown that existing T/sub 1/ relaxation models in the literature lack sufficient accuracy to adequately determine tau/sub d/ from T/sub 1/ data for the $TiH_{1.55}$ and $TiH_{1.71}$ hydrides. A computer simulation T/sub 1/ relaxation model which includes spatial self, pair, and temporal correlation effects is developed. The model is applied to NN and 3NN hopping on a simple cubic lattice. For each jump mechanism, values of T/sub $1/^{-1}$ versus ω tau/sub d/ are presented for several hydrogen concentrations. An analysis of the temperature dependence of T/sub 1/ by this new model suggests that the activation energy for hydrogen motion in γ-TiH/sub x/ is approximately 9% higher than previously reported. For γ-TiH/sub x/ it is shown that hydrogen predominatly jumps to NN sites.

8882 (INKA-Conf—79-042-000(Vol.2), pp 418-424) **Photoelectron spectroscopy of metal dihydrides.** Weaver, J.H. (Univ. of Wisconsin, Stoughton); Peterson, D.T. 1979.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

Synchrotron radiation was used for photoelectron spectroscopy studies of the trivalent and tetravalent dihydrides of Sc, U, Lu, Er, and Zr. The results presented here emphasize YH_2. Comparisons are made between experiment and the theoretical results of Peterman et al. It is shown that there is generally excellent overall agreement between theory and experiment.

8883 (PNL-SA—7992, pp 147-157) **X-ray photoemission spectroscopy (XPS) and extended x-ray absorption fine structure (EXAFS) studies of silicate based glasses.** Karim, D.; Lam, D.J. (Argonne National Lab., IL). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

The application of the x-ray photoemission spectroscopy (XPS) technique to study the electronic structure and bonding of heavy metal oxides in alkali- and alkali-earth-silicate glasses had been demonstrated. The bonding characteristics of the iron oxide and uranium oxide in sodium silicate glasses were deduced from the changes in the oxygen 1s levels and the heavy metal core levels. It is reasonable to expect that the effect of leaching on the heavy metal ions can be monitored using the appropriate core levels of these ions. To study the effect of leaching on the glass forming network, the valence band structure of the bridging and nonbridging oxygens in sodium silicate glasses were investigated. The measurement of extended x-ray absorption fine-structure (EXAFS) is a relatively new analytical technique for obtaining short range (<5 A) structural information around atoms of a selected species in both solid and fluid systems. Experiments have recently begun to establish the feasibility of using EXAFS to study the bonding of actinides in silicate glasses. Because of the ability of EXAFS to yield specific structural data even in complex multicomponent systems, it could prove to be an invaluable tool in understanding glass structure.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 8009, 8885

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 8009, 8135, 8737, 8759, 8885, 9511

8884 (BNL—26813) **Hydrogen storage materials research and development work at Brookhaven National Laboratory.** Johnson, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 4p. (CONF-791127—2). Dep. NTIS, PC A02/MF A01.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

The intermetallic compound $TiCr_2$ exists as two temperature dependent allotropes. Both forms of this material will react with hydrogen or deuterium reversibly to yield two hydride (deuteride) phases. The higher hydride/deuteride phases can store an appreciable weight percent of gas. The hydride and deuteride phases formed by the two intermetallics are generally very unstable thermodynamically with the deuterium systems more stable than the corresponding hydrides of the same intermetallic. This paper is a brief progress report encompassing research done from October 1, 1978 to September 30, 1979 at Brookhaven National Laboratory dealing with properties of importance in the utilization of $TiCr_2$ intermetallics (parent compounds or substituted systems) as energy storage media or for nonmechanical compression/liquefaction applications. Additionally, preliminary research into the feasibility of hydrogen separation from mixed gas streams, using intermetallic compounds, will be briefly reported.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 8008, 8014, 8018, 8996

RADIATION EFFECTS

8885 (PNL—3064) **ThO_2-based pellet fuels - their properties, methods of fabrication, and irradiation performance: a critical assessment of the state of the technology and recommendations for further work.** Hart, P.E.; Griffin, C.W.; Hsieh, K.A.; Matthews, R.B.; White, G.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 167p. Dep. NTIS, PC A08/MF A01.

This critical assessment of the ThO_2-UO_2 pellet fuel technology was conducted in support of the Fuels Refabrication and Development Program (FRAD). Included in this critical review are the following areas: powder preparation; pellet fabrication; fuel chemical, physical, and mechanical properties; and fuel irradiation per-

formance. The authors identify (1) areas where data are either deficient or lacking and (2) requirements for additional development and experimental work.

8886 (PNL-SA—7992, pp 83-91) **Gamma-irradiation effects on leaching characteristics of waste containment materials.** McVay, G.L. (Battelle Pacific Northwest Lab., Richland, WA). 1979.

In Proceedings of the Task 2 workshop Waste Isolation Safety Assessment Program.

Materials which contain typical radioactive waste are subjected to gamma-irradiation from the waste itself. Therefore, it is important to understand the effect of this irradiation on the leaching characteristics of waste containing materials in the event of an exposure to water during the time span when significant gamma-irradiation is occurring. With this goal in mind, an experiment has been initiated to characterize the leaching behavior of 7668 glass, supercalcine ceramic, and UO_2 during exposure to gamma-irradiation.

COMPOSITE MATERIALS

PREPARATION AND FABRICATION

8887 **Alternate method of preparing polymer concrete from mixtures of liquid and solid monomers.** Carciello, N.R.; Zeldin, A.N.; Kukacka, L.E. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *J. Appl. Polym. Sci.;* **24**: No. 10, 2191-2193(15 Nov 1979).

This study was performed to facilitate the handling of solid monomers for commercial usage and to confirm the belief that these monomers can be incorporated into aggregates to produce high-strength, chemically resident, and thermally stable PC (polymer concrete). In the monomer system mentioned, the curing temperature is 60°C. Evidently at this temperature the Aa (acrylamide) or MAa (methacrylamide) dissolves in the surrounding liquid monomer before polymerization occurs. There appears to be no segregation of constituents. However, thorough mixing of the solid monomer is essential for a good particle distribution, otherwise the desired ratio of monomers to form complete copolymers will not be achieved. It can be seen in the thermal analysis, and physical properties, that both hot and room-temperature methods of preparation can be used to produce the same product.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 8887

8888 **Isotropic properties of platelet-reinforced media.** Christensen, R.M. (Univ. of California, Livermore). Contract W-7405-ENG-48. *J. Eng. Mater. Technol.;* **101**: No. 3, 299-303(Jul 1979).

The effective moduli are derived for a composite material containing platelet-type inclusions. The platelets are taken to be randomly oriented in three-dimensional space and to have so large a diameter-to-thickness ratio that edge effects can be neglected. The effective moduli that are derived reduce to known results in the special case of a dilute suspension. Comparisons are made with the corresponding type of composite medium that involves randomly oriented fibers. For the same volume fraction of reinforcing phase, the platelet case provides a stiffening effect about three times greater than the fiber case.

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 8890

8889 (SAND—79-6005) **Method for preparing macromolecular polyoxymethylene.** Barbare, L.V.; Dubovitsky, F.I.; Dremin, A.N. 27 Nov 1979. Translation of . French Patent 2,205,546. 11p. Dep. NTIS, PC A02/MF A01.

The present invention is concerned with the methods for preparing macromolecular polyoxymethylene (polyformaldehyde) from crystalline trioxane. A method for preparing macromolecular polyoxymethylene from polycrystalline trioxane by means of shock compression is already known. One of the drawbacks of this method is that the polyoxymethylene produced exhibits a relatively low degree of crystallinity and low molecular weight, which may cause this material to lack sufficient mechanical strength and wear resistance. Another drawback of this method is its low yield of the final product. The object of this invention is to eliminate these disadvantages. To this aim, using a method for the preparation of macromolecular polyoxymethylene in which the raw material is polymerized by shock compression, it became necessary to modify the raw material so as to obtain polyoxymethylene having higher crystallinity and molecular weight and, consequently, higher mechanical strength and greater wear resistance. According to this invention this problem is solved by using monocrystalline trioxane instead of crystalline trioxane.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 8927

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 8249

8890 (BNL—26864) **Effect of monomer composition on the properties of high temperature polymer concretes.** Zeldin, A.; Kukacka, L.E.; Carciello, N. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract EY-76-C-02-0016. 2p. (CONF-800303—1). Dep. NTIS, PC A02/MF A01.

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

The effects of organic monomer composition on the thermomechanical properties of polymer concrete (PC) containing sand-cement mixtures as an agregate filler were investigated. The effects of various monomer mixtures on compressive strength and hydrolytic stability are discussed. Composites were fabricated in the same way as ordinary concrete, with monomer solutions of various compositions and concentrations used to bind the sand-cement mixture. The compressive strengths of th composites before and after exposure to air and to brine solutions at 240°C are discussed.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 8249, 8259

8891 **Shock-induced electrical activity in polymeric solids. A mechanically induced bond scission model.** Graham, R.A. (Sandia Labs., Albuquerque, NM). *J. Phys. Chem.;* **83**: No. 23, 3048-3056(Nov 1979).

When polymeric solids are subjected to high-pressure shock loading, two anomalous electrical phenomena, shock-induced conduction and shock-induced polarization, are observed. The present paper proposes a model of mechanically induced bond scission within the shock front to account for the effects. An experimental study of shock-induced polarization in poly(pyromellitimide) (Vespel SP-1) is reported for shock compressions from 17 to 23% (pressures from 2.5 to 5.4 GPa). Poly(pyromellitimide) is found to be a strong generator of such polarization and the polarization is found to reflect an irreversible or highly hysteretic process. The present measurements are combined with prior measurements to establish a correlation between monomer structure and strength of shock-induced polarization; feeble signals are observed in the simpler monomer repeat units of poly(tetrafluoroethylene) and polyethylene while the strongest signals are observed in more complex monomers of poly(methyl methacrylate) and poly(pyromellitimide). It is also noted that there is an apparent correlation between shock-induced conduction and shock-induced polarization. Such shock-induced electrical activity is also found to be well correlated with the propensity for mechanical bond scission observed in experiments carried out in conventional mechanochemical studies. The bond scission model can account for characteristics observed for electrical activity in shock-loaded polymers and their correlation to monomer structure. Localization of elastic energy within the monomer repeat unit or along the main chain leads to the different propensities for bond scission and resulting shock-induced electrical activity.

RADIATION EFFECTS

8892 **Entanglement networks of 1,2-polybutadiene crosslinked in states of strain. VII. Stress-birefringence relations.** Kan, H.C.; Carpenter, R.L.; Ferry, J.D. (Univ. of Wisconsin, Madison). *J. Polym. Sci., Polym. Phys. Ed.;* **17**: No. 11, 1855-1869(Nov 1979).

Crosslinks are introduced by γ irradiation into 1,2-polybutadiene while strained in uniaxial extension near T/sub g/ with stretch ratio λ_0, thereby trapping a proportion of the entanglements originally present. The stress at any subsequent strain λ is accurately given by the sum σ/sub N/ + σ/sub x/, where σ/sub N/ is the stress contributed by a trapped entanglement network with $\lambda = 1$ as reference and a Mooney-Rivlin stress-strain relation, and σ/sub x/ is that contributed by a crosslink network with $\lambda = \lambda_0$ as reference and neo-Hookean stress-strain relation. The birefringence is accurately given as Δn = C/sub N/σ/sub N/ + C/sub x/σ/sub x/, where the C's are the respective stress-optical coefficients. From measurements at $\lambda = \lambda_0$ where σ/sub x/ = 0, C/sub N/ can be determined separately. For polymer with 88% 1,2-microstructure, C/sub N/ and C/sub x/ are nearly equal and independent of irradiation dose, though strongly dependent on temperature. For polymer with (95-96)% 1,2, C/sub N/ and C/sub x/ are different (even

opposite in sign) and dependent on dose. This behavior is associated with a side reaction of cyclization by the γ irradiation, which is inhibited by the 1,4 moiety in the polymer with lesser 1,2 content. It is responsible for residual birefringence in the state of ease (λ = λ/ sub s/) where σ/sub N/ = -σ/sub x/ and the stress is zero.

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 8248, 8250, 8252, 8257, 8263, 8267, 8268, 8270, 8271, 8272, 8273, 8274, 9035

8893 (CONF-7910101—1) **Press forging and optical properties of lithium fluoride.** Ready, J.F.; Vora, H. (Honeywell Corporate Material Sciences Center, Bloomington, MN (USA)). 1979. Contract ED-78-C-08-1555. 9p. Dep. NTIS, PC A02/MF A01.

From Symposium on optical materials for high power lasers; Boulder, CO, USA (30 Oct 1979).

Lithium fluoride is an important candidate material for windows on high-power, short-pulse ultraviolet and visible lasers. Lithium fluoride crystals have been press forged in one step over the temperature range 300 to 600°c to obtain fine-grained polycrystalline material with improved mechanical properties. The deformation that can be given to a lithium fluoride crystal during forging is limited by the formation of internal cloudiness (veiling) with the deformation limit increasing with increasing forging temperature from about 40% at 400°C to 65% at 600°C. To suppress veiling, lithium fluoride crystals were forged in two steps over the temperature range 300 to 600°C, to total deformations of 69-76%, with intermediate annealing at 700°C. This technique yields a material which has lower scattering with more homogeneous microstructure than that obtained in one-step forging. The results of characterization of various optical and mechanical properties of single-crystal and forged lithium fluoride, including scattering, optical homogeneity, residual absorption, damage thresholds, environmental stability, and thresholds for microyield are described.

8894 (SAN—0113/35-1) **Evaporation driven liquid sintering. Progress report.** Whelan, J.M. (University of Southern California, Los Angeles (USA)). Aug 1979. Contract EY-76-S-03-0113-035. 13p. Dep. NTIS, PC A02/MF A01.

Reaction driven liquid sintering mechanisms with MgO-LiF were studied including the effects of varying the LiF particle size distribution within the cold pressed compacts, microstructural and bulk property differences, and the time rate changes in the mechanical properties during permeation annealing. (FS)

PROPERTIES

REFER ALSO TO CITATION(S) 8245, 8246, 8272, 8274, 8849, 8893, 9013

8895 (COO—4269-1) **Phase I: energy conservation potential of portland cement particle size distribution control. Progress report, May-July 1978.** Helmuth, R.A. (Portland Cement Association, Skokie, IL (USA)). Oct 1978. Contract EC-77-C-02-4269. 22p. Dep. NTIS, PC A02/MF A01.

Test results are presented which more precisely define the amounts of fine particles required to obtain both adequate paste flow and strength development in Portland cement. Controlled particle size ranges with maximum sizes of 45, 20, and 14 microns were used with various amounts (0 to 45%) of 8 to 1 micron added fines. Better strength development was obtained with a maximum particle size of 20 microns than with 45 or 14 microns at equal finenesses, (2,900 to 3,000 cm^2/g), or with normally ground cement of higher fineness (3,655 cm^2/g). The flow of pastes made with this 20 micron cement was not quite as good as that of the 45 micron or normally ground cements. The data indicate that increasing the maximum particle size to 30 microns may be advantageous, and that the amounts of added fines for optimum performance lies between about 10 and 25%. Materials are being prepared for the further tests with maximum particle sizes of 30 and 20 microns with 10 to 25% fines additions.

8896 (SAND—79-0649) **Correlation of nosetip boundary-layer transition data measured in ballistics-range experiments.** Reda, D.C. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 61p. Dep. NTIS, PC A04/MF A01.

Preablated nosetips of various carbonaceous materials were tested in a ballistics range. Surface-temperature contours, measured with image-converter cameras, were used to define boundary-layer transition-fron contours. Measurements of surface roughness, surface temperature, average transition-calculations of nosetip flowfields, and with calculations of laminar boundary-layer development in these flowfields, to transform all data into various dimensionless parameters. These parameters were defined by previous attempts to correlate existing wind-tunnel data for transition on rough/blunt bodies.

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 8181

ACTIVATION AND NUCLEAR REACTION PROCEDURES

8897 **Quantitative analysis of silicates by instrumental epithermal neutron activation using (n,p) reactions.** Gladney, E.S.; Perrin, D.R. (Los Alamos Scientific Lab., NM). *Anal. Chem.;* **51**: No. 13, 2297-2300(Nov 1979).

Instrumental epithermal neutron activation (IENA) involves the use of a neutron filter to screen out the thermal portion of the reactor neutron energy spectrum. Both Cd and B are efficient neutron filters. The principal advantage of epithermal over conventional thermal neutron activation for elemental analysis of geological materials is that the most common rock forming elements, which activate strongly with thermal neutrons (Na, Al, P, K, Fe, and Sc), have their activities suppressed, relative to elements which have cross-sectional resonances in the epithermal energy region. One-gram samples of various silicate standard reference materials were encapsulated in polyethylene vials and irradiated in the Los Alamos Omega West Reactor epithermal facility. Only six elements (F, Si, Na, Fe, Ni, and Ti) were successfully determined in geological matrices via (n,p) reactions. The single standard deviations among the measurements were less than 10% in all cases. The production ratio of (n,p) to (n,γ) and (n,p) to (n,α) interfering reactions are included for silicate materials having Mason's average crustal abundance of elements. Epithermal activation via (n,p) reactions provides an alternative method for the determination of Fe, Al, Na, Ni, and F. The preferred techniques are probably thermal neutron activation for the first three elements, atomic absorption for Ni, and ion selective electrode for F.Titanium and Si can be measured much more sensitively using the (n,p) reaction than by thermal neutron activation. 4 tables.

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 8098

8898 (K—2014) **Determination of sulfate in recirculating cooling water.** Postma, F.W. Jr.; Wright, C.C. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Dec 1979. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

A specific ion electrode method for determining sulfate in recirculating cooling water was developed for the concentration range 1000 to 3000 μg SO_4^{2-}/ml. The precision of the method was L.E. (0.95) = +- 8% for a single determination, and the accuracy was < 7%. Analysis time was 1 hour.

8899 **Determination of selected munitions and their degradation products using high performance liquid chromatography.** Meier, E.P. (Army Medical Bioengineering Research and Development Lab., Fort Frederick, MD); Taft, L.G.; Graffeo, A.P.; Stanford, T.B. pp 487-488 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

High Performance Liquid Chromatography (HPLC) was used for the trace determination (< 100 ppB) of 2,4,6-trinitrotoluene (TNT), N-methyl-N,2,4,6-tetranitroaniline (tetryl), and cyclotrimethylenetrinitramine (RDX). This method is also suitable for the simultaneous determination of many of the suspected degradation products of these munitions. Additionally, HPLC techniques were applied to the simultaneous determination of trace amounts of HMX, RDX, and TNT through the direct injection of contaminated water samples.

8900 **Spectrophotometric determination of some bifunctional polynitroaromatic compounds with ethylenediamine.** Selig, W. (Univ. of California, Livermore). *Mikrochim. Acta;* **1**: 435-440(1978).

Bifunctional polynitroaromatic compounds were determined spectrophotometrically after reaction with ethylenediamine in dimethylsulfoxide. In addition to two or more nitro groups, the compounds contained one or more amino-, methoxyl-, hydroxyl-, carboxyl-, or chloride groups. Spectral data are given for all compounds examined, most of which are of ordnance interest.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 8183

8901 (EGG-PHYS—5076) **Electronics system for transuranic waste assays using a photon interrogation technique.** Johnson, L.O.; Lawrence, R.S. (Idaho National Engineering Lab., Idaho Falls (USA)). Dec 1979. Contract EY-76-C-07-1570. 69p. Dep. NTIS, PC A04/MF A01.

This report documents the development of electronics for a neutron detection system used in experiments to demonstrate the feasibility of a photon interrogation technique for transuranic (TRU) waste assays. The system consists of the neutron detection and signal conditioning circuits, variable time-gate generators, and a data acquisition system. The data acquisition system is configured using commercially available scalers, timers, teletype, and control components. The remainder of the system, with the exception of the neutron detectors, uses components designed in-house. The neutron detection system consists of ^{3}He proportional counters installed in a polyethylene moderator assembly. The counters are direct-coupled to a high-count-rate, current-sensitive preamplifier. The preamplifier and an additional two-stage amplifier are also installed in the moderator assembly. Signal conditioning includes baseline restoration and fast discrimination. A variable time-gate generator with logic gates allows for separation of prompt and delayed neutron counts, and generation of prompt and delayed deadtimes. The ^{3}He proportional counters will detect not only the neutrons from the TRU waste sample, but also the high-energy photons used to induce fission in the sample. The burst of photons (gamma flash) tends to overload and paralyze the electronics. This system has been designed to recover from a worst-case gamma flash overload within 10 microseconds. The system has met all the requirements generated for the photon interrogation experiments.

8902 (RFP—2943) **Measurement of plutonium and americium in molten salt residues.** Haas, F.X.; Lawless, J.L.; Herren, W.E.; Hughes, M.E. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1979. Contract EY-76-C-04-3533. 5p. (CONF-791117—17). Dep. NTIS, PC A02/MF A01.

From ANS topical conference; Kiawah Island, SC, USA (26 Nov 1979).

The measurement of plutonium and americium in molten salt residues using a segmented gamma-ray scanning device is described. This system was calibrated using artificially fabricated as well as process generated samples. All samples were calorimetered and the americium to plutonium content of the samples determined by gamma-ray spectroscopy. For the nine samples calorimetered thus far, no significant biases are present in the comparison of the segmented gamma-ray assay and the calorimetric assay. Estimated errors are of the order of 10 percent and is dependent on the americium to plutonium ratio determination.

8903 (UCRL—52811) **Catalytic oxidation of tritium in air at ambient temperature.** Sherwood, A.E.; Monahan, B.G.; McWilliams, R.A.; Uribe, F.S.; Griffith, C.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1979. Contract W-7405-ENG-48. 63p. Dep. NTIS, PC A04/MF A01.

Tritium/air oxidation kinetic data are derived from ambient-temperature measurements carried out with three precious-metal catalysts. Each catalyst consists of a high-surface-area substrate in pelletized form, onto which precious metal has been dispersed. The metal/substrate combinations investigated are platinum/alumina, palladium/kaolin, and palladium/zeolite. Electron-microprobe scans reveal that the dispersed metal is deposited in each case near the outer surface of the pellet, with metal concentration decreasing exponentially from the pellet surface. Kinetic oxidation measurements are made in a unique apparatus consisting of a large Lucite enclosure with an air atmosphere processed by a recirculating cleanup system. Dual-ionization chambers with an intermediate adsorption bed permit measurement of tritium gas and tritiated water vapor. Rate coefficients are determined from concentration decay following a spike injection of tritium into the enclosure. The catalytic reaction is first-order in tritium concentration in the range 10 to 10^5 μCi/m^3. Addition of hydrogen carrier gas is unnecessary. Each of the dispersed-metal catalysts is extremely active in promoting tritium oxidation in comparison with self-catalyzed atmospheric conversion; equivalent first-order rate constants are higher by roughly 9 orders of magnitude. The platinum-based catalyst is more effective than the palladium catalysts on a surface-area basis by about a factor of 3. Catalytic activity for all three catalysts declines with time of exposure to air after activation, following a power-law decay with an exponent of -1/2. A model for optimization of the catalyst reactivation cycle is proposed, revealing that the optimum catalyst volume scales with flow rate to the 2/3 power. Ambient-temperature tritium oxidation is cost-effective for small- to intermediate-scale cleanup systems. A heated catalyst is desirable for large-scale systems.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 8262, 8883, 8917, 8928

8904 (RHO-SA—81) **Facility for the analysis of radioactive samples by inductively coupled plasma spectroscopy.** Homi, C.S.; Manabe, R.M. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Oct 1979. Contract EY-77-C-06-1030. 18p. (CONF-791049—21). Dep. NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

A 29-channel polychromator and a scanning monochromator are used to determine over 60 elements by inductively coupled plasma (ICP) spectroscopy. The addition of a sample hood, special torch containment box, and an off-gas scrubber system will allow the analysis of low- to intermediate-level radioactive samples. The simultaneous multi-element analysis capabilities of the ICP reduces sample handling and total analysis time. Consequently, the potential for radiation exposure to personnel will be reduced.

8905 **Hydroxyl anion chemical ionization screening of liquid fuels.** Sieck, L.W. (National Bureau of Standards, Washington, DC); Jennings, K.R.; Burke, P.D. *Anal. Chem.;* **51**: No. 13, 2232-2235(Nov 1979).

The use of OH^- as a reagent ion for chemical ionization screening of the aromatic components in liquid fuels is discussed. The hydroxyl anions were generated by the reactions of O^-, from N_2O, with hexane, which also served as the solvent for the fuel samples. The resulting mass spectra were characterized by the absence of measurable signals from aliphatic components. The method requires no prior fractionation or separation, as well as a 2 to 3 minute turn-around time between successive analyses. Some preliminary data pertinent to determinations of actual molecular weight distributions by this technique are also presented. 4 figures, 1 table.

8906 **Development of improved portable x-ray fluorescent lead paint analyzers and lead paint reference standards.** Cramp, A.P.; Berger, H.W. (National Bureau of Standards, Washington, DC). pp 354-359 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Portable x-ray fluorescent lead analyzers offer the most cost-effective rapid and adaptable means for the non-destructive detection and measurement of lead paint in housing. Commercially available portably lead analyzers have had poor accuracy and precision below lead levels of about 2 milligrams lead per square centimeter of surface area. They have also performed relatively unsatisfactorily with regard to service-ability and maintenance. Two new portable lead analyzers, based on x-ray fluorescence, were developed. The prototypes of one of these devices have shown considerable improvement over previously available instruments in terms of accuracy, portability, and user characteristics. Lead paint reference materials containing 0.6, 1.5, and 3.0 mg/cm^2 lead were developed for distribution to users of portable x-ray fluorescent lead analyzers for purposes of calibration and instrument performance assessment. The performance and operating characteristics of the lead analyzers and the lead paint reference material are discussed.

8907 **Interference of aromatic hydrocarbons in the determination of PCB's.** Zitko, V. (Fisheries and Environment Canada, St. Andrews, New Brunswick). pp 757-760 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Fluoranthene (I) and pyrene (II) are present in high concentrations in some marine invertebrates and are not separated from polychlorinated biphenyl's (PCB) by certain cleanups. Under routine gas chromatography (GC) conditions for PCB analysis, their peaks coincide with the first two major peaks of Aroclor 1254. The electron-capture detector response to I and II is considerably lower than its response to chlorobiphenyls, but if the weight ratio of I and/or II to PCB's is $>5:1$, an erroneously high concentration of PCB may be reported. I and II were determined by GC/MS and PCB's by a routine technique in samples of mussels (Mytilus edulis), periwinkles (Littorina littorea), whelks (Buccinum undatum and Neptunea decemostata), clams (Mya arenaria), and lobster (Homarus americanus) hepatopancreas. The concentration of I and II was 2 to 96 μg/g lipid and the error in PCB concentration was up to 100% in some samples. I and II can be separated from PCB by column chromatography on silica.

8908 **Analysis of organotins in the environment.** Riggle, C.J.; Sgontz, D.L.; Graffeo, A.P. (Battelle Columbus Labs., OH). pp 761-764 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A method was developed for the analysis of organotin compounds in the environment. It is capable of quantifying individual organotin compounds and their transformation products at low levels in environmental samples. The method developed comprises three steps: concentration of the organotin compounds by dynamic adsorption on silica gel; speciation by chromatography; and, quantitation by atomic absorption spectroscopy. Detection levels of organotin compounds in environmental samples were: air - 0.1 $\mu g/m^3$, water - 100 ppB, soil - 1 ppM.

8909 Atomic absorption spectrophotometric determination of some trace metals in biological systems. Hung, G.W.C. (American Biomedical Corp., Memphis, TN). pp 765-770 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Methods for the determination of trace metals such as As, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, and Zn in various biological systems by flame (FAAS) and flameless (nonflame, NFAAS) atomic absorption spectrophotometry are described. In addition, some common metals, Ca, Fe, Mg, K, and Na, which are essential to and present at higher concentration levels in the same systems are also analyzed simultaneously. Prior to analysis, sample materials were pretreated by direct dry ashing and wet digestion techniques to remove organic matter and other interfering substances and brought into aqueous solutions. The metal concentrations in $\mu g/ml$ in the prepared sample solutions were then determined by the standard calibration method utilizing FAAS and NFAAS techniques. The concentrations of trace metals thus found ranged from 0.01 parts per million (ppM) to larger than 1000 ppM depending upon the individual metals analyzed. The results indicated that biological sample preparation by either direct dry ashing or wet digestion procedures gave similar or identical elemental composition and concentration levels.

8910 Ultrasensitive metallic vapor detection by SONRES. Gelbwachs, J.A.; Klein, F.; Wessel, J.E. (Aerospace Corp., Los Angeles, CA). pp 771-774 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The results using a novel method of atomic fluorescence detection employing laser excitation are presented. The method of SONRES (Saturated Optical Nonresonant Emission Spectroscopy) exploits efficient energy transfer between excited atomic states and intense optical fields available from dye lasers. The technique, which is simple to implement, operates most effectively at high pressures and thus ideally couples to practical atomization sources such as combustion flames and electrical furnaces. Results are shown for three important environmental species: platinum, nickel, and sodium. Analytical curves exhibit linearity over five decades. In an electrical furnace a detection limit of $\sim 10^6$ atoms/cm^3 was recorded for both platinum and nickel. In a combustion flame, 10^8 atoms/cm^3 of sodium were monitored. In an enclosed cell buffered with argon, 200 sodium atoms/cm^3 were monitored. Little effort was taken to optimize the experimental configuration when these results were obtained. Instrumentation refinement will undoubtedly lead to even lower detection limits. It is predicted that the SONRES method can be applied to more than 45 elements of environmental and biological importance.

8911 Absorption spectra of Zr atoms and ZrN isolated in rare gas matrices. Bates, J.K.; Gruen, D.M. (Argonne National Lab., IL). *High Temp. Sci.;* **10**: 27-43(1978).

Absorption spectra of Zr isolated in Ar, Kr, and Xe matrices at 14 K are reported. The matrix spectra are correlated with known gas-phase data using the AMCOR method, and the Zr atoms are shown to occupy single or double substitutional sites depending on the method of metal atom production. Using a hollow cathode source and N_2, the diatomic molecule ZrN has been produced and isolated in Ar matrices. The electronic and vibrational spectra are reported, allowing the molecular ground state to be unambiguously identified and the ground state vibrational constants to be determined. 7 figures, 8 tables.

8912 Spectroscopy by inverse Raman scattering. Yeung, E.S. (Ames Lab., IA). pp 193-214 of New applications of lasers to chemistry. Hieftje, G.M. (ed.). Chicago, IL; American Chemical Society (1978).

Spectroscopy by inverse Raman scattering (SIRS) is one of many new techniques in molecular spectroscopy made possible by the development of high power lasers. Although SIRS was first demonstrated experimetally by Jones and Stoicheff in 1964 (1), its growth was somewhat limited by certain technical difficulties. However, some of the properties inherent to SIRS show good potential for applications in chemistry, ranging from high resolution spectroscopy to chemical analysis. 39 references, 5 figures.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 8950

8913 Catalytic gas purification process. Clements, P.; Basila, M.R.; Barry, J.J. (to Nalco Chemical Co.). US Patent 4,153,671. 8 May 1979. Filed date 13 Jan 1977. 8p.

Hydrogen-containing gas mixtures including saturated and unsaturated hydrocarbon gases, carbon monoxide and organic sulfur contaminants are purified by passing them over a hydrogenation catalyst containing phosphorus with the addition of predetermined limited amounts of water. The process makes it possible to produce hydrogen-containing gases which can be used for hydrogenation processes with the elimination or reduction of carbon monoxide, olefins and organic sulfur, all brought about simultaneously by passing the gas mixture over the same catalyst and in the same reactor. 4 claims.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 8043, 8207, 8929, 8935

8914 (ORO—1797-92) Research in nuclear chemistry. Progress report. Choppin, G.R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1980. Contract EY-76-S-05-1797. 30p. Dep. NTIS, PC A03/MF A01.

The research is concerned primarily with complexes in aqueous solution of actinide elements. Actinides in the trivalent oxidation state have been studied more than species in other valence states. Similar systems have also been investigated for the trivalent lanthanides. Since 15 lanthanides can be studied using a wider variety of techniques than feasible with the actinides (e.g., NMR), comparison of these closely related families of elements using the greater amount and variety of lanthanide data provides better understanding of actinide behavior. The studies have included measurements of the thermodynamic parameters of complexation for both inorganic and organic ligands, of the kinetics of complexation, of the spectroscopic properties of complex species using f reverse arrow f electronic transitions, of the nuclear magnetic resonance spectroscopy of the complexed ligands and of binding to natural polyelectrolytes such as humic acid.

8915 Rapid heating evaporation of $Pb(NO_3)_2$. Evidence for heterogeneous ion-molecule reactions. Radus, T.P.; Udseth, H.R.; Friedman, L. (Brookhaven National Lab., Upton, NY). *J. Phys. Chem.;* **83**: No. 23, 2969-2975(Nov 1979).

A mass spectrometric investigation of the lead nitrate system is reported in which the lead nitrate was evaporated from a probe filament that was heated as rapidly as 5000°C/s. Both electron impact (EI) and chemical ionization (CI) source techniques were used in this study. Fragment ions and decomposition products were observed under EI conditions. Under CI conditions solvated fragment ions and protonated solvated molecular ions were detected. Temperature measurements of rates of evaporation were made by monitoring the resistance of the probe filament as it was heated. Activation energies calculated by using these temperature coefficients of evaporation rates indicate that evaporations under CI conditions are assisted by heterogeneous ion-molecule reactions.

8916 Reactions of quinuclidine N-oxide and other amine oxides with sulfur dioxide. Structure of quinuclidine sulfur trioxide. Kubas, G.J.; Larson, A.C.; Ryan, R.R. (Univ. of California, Los Alamos, NM). *J. Org. Chem.;* **44**: No. 22, 3867-3871(26 Oct 1979).

Passage of SO_2 gas through solutions of quinuclidine N-oxide in water or undried organic solvents at ambient temperature resulted in precipitation of sparingly soluble colorless platelets of quinuclidine sulfur trioxide in 85 to 90% yields. Reaction in dry benzene gave a mixture of QN-SO_3, QN-OSO_3, and QN.H_2SO_3 (QN = quinuclidine). Addition of SO_2 to a mixture of oxides of triethylenediamine in H_2O yielded $O_3SN(CH_2CH_2)_3NSO_3$. A kinetic study showed that hydrolysis of QN-SO_3 in water is exceedingly slow, even at 86°C. The hydrolysis is first order and occurs at a rate ($9.3 \times 10^{-7} s^{-1}$) which is 280 times slower than the analogous rate for Et_3N-SO_3. Alkaline hydrolysis of QN-SO_3 was moderately fast, yielding QN and sulfate. A single-crystal x-ray structure determination of QN-SO_3 confirmed the expected sulfamic acid type coordination of SO_3 to QN (N-S = 1.831(6) A). Cell data: space group $P2_1/m$, a = 7.955 (4), b = 8.829 (3), c = 6.100 (4) A, β = 96.03 (4)°, R = 0.052, R/sub w/ = 0.031 for 491 diffractometer-collected reflections with $I \geq 3\sigma$ (I) and symmetry-parameterized rigid-body model refinement. 1 figure.

8917 Derivatization of surfaces via reaction of strained silicon-carbon bonds: characterization by photoacoustic spectroscopy. Fischer, A.B.; Kinney, J.B.; Staley, R.H.; Wrighton, M.S. (Massachusetts

Inst. of Tech., Cambridge). Contract EG-77-S-02-4178.A002. *J. Org. Chem.;* **44**: No. 22, 6501-6506(26 Oct 1979).

Ferrocene-centered reagents can be bound to the surface of high surface area (400 m^2/g) silica by reaction of the silica with alkane solutions of (1,1'-ferrocenediyl)dichlorosilane (Ia), (1,1'-ferrocenediyl)dimethylsilane (Ib), or (1,1'-ferrocenediyl)diphenylsilane (Ic). Derivatization is not found when ferrocene itself is used as the derivatization reagent; ferrocene is easily washed from the silica powder by solvents which do not affect the ferrocene centers bound upon reaction of the silica with Ia-c. As determined by photoacoustic spectroscopy, derivatization with Ia-c results in ring opening of the strained C-Si-C linkage bridging the two cyclopentadienyl rings to yield a simple, monosubstituted ferrocene center attached to the surface. Surface -OH functionality apparently reacts in a manner analogous to homogeneous solution sources of -OH such as MeOH. Reaction of Ib with MeOD yields [Fe(eta^5-C_5H_4D)(eta^5-$C_5H_4Si(OMe)Me_2$)]. Optical absorption spectral changes accompanying reaction of Ia-c with solution sources of -OH are consistent with the differences found in the photoacoustic spectra of the pure powders of Ia-c compared to the silica powders derivatized with these reagents. Reaction of silica powders derivatized with Ia-c with acidic solutions of benzoquinone results in the oxidation of the surface-confined ferrocene centers to ferricenium centers giving photoacoustic spectra nearly the same as that from an authentic sample of a pure ferricenium salt. The surface-confined ferricenium can be used to oxidize N,N,N',N'-tetramethyl-p-phenylenediamine (TMPD) to $TMPD^+$. in solution; this reaction allows an estimate of the surface coverage at 10^{-11} mol/cm^2. 3 figures, 2 tables.

8918 Properties and reactions of manganese methylene complexes in the gas phase. The importance of strong metal: carbene bonds for effective olefin metathesis catalysts. Stevens, A.E.; Beauchamp, J.L. (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.;* **101**: No. 21, 6449-6450(10 Oct 1979).

In this communication the formation, properties and reactions of the gas phase carbenes $MnCH_2^+$, $(CO)_5MnCH_2^+$, and $(CO)_4MnCH_2^+$ are described. Reported results include observation of metathesis and abstraction reactions of the methylene ligand with olefins and the first experimental determination of metal-carbene bond dissociation energies. Important points are that: (a) metal-methylene bond energies are extremely strong; and (b) the Mn^+-methylene bond energy is decreased substantially on addition of five carbonyls to the metal center. If the metal-carbene bond energy exceeds 100 kcal/mol, then transfer of the carbene to an olefin to give a cyclopropane or new olefin will be endothermic and thus will not compete with the metathesis reaction. In order to avoid low turnover numbers resulting from consumption of carbene intermediates, strong metal-carbene bonds are a desirable feature of practical metathesis catalysts. (DP)

8919 Apparent and partial molal heat capacities of aqueous rare earth nitrate solutions at 25°C. Spedding, F.H.; Baker, J.L.; Walters, J.P. (Iowa State Univ., Ames). *J. Chem. Eng. Data;* **24**: No. 4, 298-305(Oct 1979).

Specific heats of aqueous solutions of the trinitrates of La, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu were measured from 0.1 m to saturation at 25°C. Apparent molal heat capacities, phi/sub cp/, were calculated for these solutions, and empirical polynomial equations were obtained which expressed phi/sub cp/ as a function of m/sup 1/2/ for each salt. The partial molal heat capacities of the solvent, anti C_1/sub p/, and solute, anti C_2/sub p/, were calculated from these equations. Unlike chloride and perchlorate data reported earlier, values of anti C_1/sub p/ for nitrate solutions across the rare earth series did not show a two series effect. Instead, anti C_1/sub p/ values at lower concentrations (0.5 and 1.0 m) appear correlated with reported first formation constants for rare earth-nitrate complexes. 31 references, 9 figures, 2 tables.

8920 Isopiestic determination of the activity coefficients of some aqueous rare earth electrolyte solutions at 25°C. 4. $La(NO_3)_3$, $Pr(NO_3)_3$, and $Nd(NO_3)_3$. Rard, J.A. (Univ. of California, Livermore); Miller, D.G. *J. Chem. Eng. Data;* **24**: No. 4, 348-354(Oct 1979).

The osmotic coefficients of aqueous $La(NO_3)_3$, $Pr(NO_3)_3$, and $Nd(NO_3)_3$ solutions have been measured from 0.1 mol kg^{-1} to 6.2 to 6.4 mol kg^{-1} at 25°C by using the isopiestic method. The resulting osmotic coefficients were fitted to semiempirical least-squares equations, and these equations were used to calculate water activities and mean molal activity coefficients. The data up to 2.0 mol kg^{-1} were also fitted to Pitzer's equation. These data are compared to other available thermodynamic and transport data for rare earth electrolyte solutions. 7 figures, 5 tables.

8921 Method of locating extrema in multicomponent three phase systems. Vinatieri, J.E.; Fleming, P.D. III. (to Phillips Petroleum Co.). US Patent 4,154,300. 15 May 1979. Filed date 12 Apr 1978. 20p.

The object of this invention is to locate extrema in the intensive physical properties of multicomponent systems. Another object is to reduce the experimental work required to optimize multicomponent systems and to circumvent the difficulty inherent in interaction between components of a multicomponent system which makes optimization difficult. A further object of this invention is to provide a surfactant system suitable for producing a microemulsion with low interfacial tension for use in oil recovery. Each of three phases of either an actual sample or a composite system determined by regression analysis is analyzed and the results are subjected to Gram-Schmidt Orthogonalization to determine the composition of at least one component. 14 claims.

8922 Spectral moments of solvated electrons. Carmichael, I. (Univ. of Notre Dame, IN). *Chem. Phys. Lett.;* **56**: No. 2, 339-342(1 Jun 1978).

A moment theory analysis is performed on the optical absorption spectra of surplus electrons localized in various media. The deduced attributes of the excess particle are compared with those obtained by a perturbation treatment of the exact ground state solution of a currently popular model potential for the species. Several frequency dependent observables are evaluated and a source of inadequacy in the current theory, the presence of a Coulomb tail, is revealed.

8923 Analysis of the use of energy differences in explaining solvent effects on photophysical processes. Hug, G. (Univ. of Notre Dame, IN). *Chem. Phys. Lett.;* **55**: No. 3, 596-598(1 May 1978).

This letter contains a discussion of the implicit approximations involved in using energy differences to explain solvent effects on photophysical processes. The adequacy of expressions resulting from these approximations is investigated by comparing the expressions to the exact perturbation expansions. The physical model implicit in these approximations is also discussed.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 8924

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

8924 (COO—5031-1) Solvent and solute isotope effects in the aqueous solution of gases. Progress report, July 1, 1978-October 31, 1979. Benson, B.B.; Krause, D. Jr. (Amherst Coll., MA (USA)). Oct 1979. Contract ER-78-S-02-5031. 19p. Dep. NTIS, PC A02/MF A01.

After developing a $^3He/^4He$ dual beam collection system for the mass spectrometer, the isotopic fractionation factor was determined for helium dissolved in H_2O, D_2O, seawater and ethanol. In all solvents the temperature dependence of the fractionation is different from that for a simple isotope vapor pressure effect. Addition of salt to H_2O increases the fractionation, and the relative salting-out coefficient changes with temperature. A double isotopic effect occurs - the fractionations in D_2O and H_2O differ. In ethanol the fractionation is 25% less than in H_2O.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 8043, 8088, 8221, 8917, 9274, 9292

8925 (COO—5141-2) Improvement of yields and rates during enzymatic hydrolysis of cellulose to glucose. Progress report, March 1, 1979-May 31, 1979. Sundstrom, D.W.; Klei, H.E.; Coughlin, R.W. (Connecticut Univ., Storrs (USA)). May 1979. Contract ET-79-S-02-5141. 14p. Dep. NTIS, PC A02/MF A01.

The objective of this program is to show that the conversion of cellulose to glucose can be significantly increased by enzymatically removing the inhibitory cellobiose from the reaction system using immobilized β-glucosidase (β-G). An enzymatic catalyst was prepared and used in a fluidized bed with cellobiose as the substrate, only a 10% loss of activity was observed during a 500 hour period. Cellulose was hydrolyzed in two batch reactors operated side-by-side, with one reactor containing immobilized β-G and cellulose and the other reactor containing an equal amount of cellulose only. After 30 hours the reactor containing the immobilized β-G had 100% more glucose, indicating that the catalytic removal of the cellobiose had a significant effect upon the production of glucose.

8926 (UCRL—15119) Nitroalkyltetrazoles. Final report, January-September 1979. Grakauskas, V.; Albert, T.H. (Fluorochem, Inc., Azusa, CA (USA)). Oct 1979. Contract W-7405-ENG-26. 20p. Dep. NTIS, PC A02/MF A01.

The objective of this work was the synthesis of low hydrogen content 1- or 5-substituted polynitroalkytetrazoles utilizing as the starting materials several available polynitroalkyl azides and polynitroalkylnitriles. Fluorodinitroacetonitrile, trinitroacetonitrile, methyl cyanodinitroacetate, alkali salts of cyanodinitromethide, and

fluorodinitroethyl azide were used in this work. The experimental approach to this goal was based on utilization of a well known condensation reaction of azides with nitriles yielding tetrazole derivatives. Two 5-substituted tetrazoles, 5-(fluorodinitromethyl)tetrazole and 5-(trinitromethyl)tetrazole, were obtained by reacting fluorodinitroacetonitrile and trinitroacetonitrile, respectively, with sodium azide and trimethylsilyl azide. These two tetrazoles were characterized as their ammonium salts. Methyl cyanoacetate did not form tetrazoles in its reaction with azides. Fluorodinitroethyl azide did not react with either sodium azide or organic azides.

8927 Interaction mechanisms between poly(methyl methacrylate) and tricalcium silicate (C_3S). Sugama, T.; Kukacka, L.E.; Horn, W. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *J. Appl. Polym. Sci.;* **24**: No. 10, 2121-2135(15 Nov 1979).

Interaction mechanisms between poly(methyl methacrylate) (PMMA) molecules and tricalcium silicate (C_3S) occurring in a C_3S-filled PMMA molecular structure before and after exposure to a simulated 25% geothermal brine solution at 240°C have been investigated by use of thermal analysis, infrared spectroscopy analysis, scanning electron microscopy, and compressive strength tests. For C_3S-filled PMMA samples before exposure to hot brine, it was observed that an interaction between the C_3S filler and the CH_2 groups in the main chain of the PMMA occurred. After exposure to the hydrothermal environment, indications were that the brine solution induced ionic bonding between the carboxylate anion ($-COO^-$) groups in the PMMA and the Ca^{2+} ions from the C_3S. The reaction contributed to improvements in the thermal stability of the PMMA.

8928 Facile entry into the thiazolo[3,2-a]indol-3(2H)-one system via an unusual reaction with thionyl chloride. Showalter, H.D.H. (Ohio State Univ., Columbus); Shipchandler, M.T.; Mitscher, L.A.; Hagaman, E.W. Contract W-7405-ENG-26. *J. Org. Chem.;* **44**: No. 22, 3994-3996(26 Oct 1979).

This study included investigations into the canthin-6-one series. γ-oxo-3[(methoxycarbonyl)methyl]-1H-indole-1-butanonic acid (1a) was treated with oxalyl chloride to give the acid chloride (1b) $R_1 = CO_2CH_3$; $R_2 = Cl$. Similar reaction of (1a) with refluxing thionyl chloride followed by methanol treatment did not give the expected methyl ester (1c) but instead gave orange fibrous needles of (2a) in 20% yield. The corresponding reaction of γ-oxo-3-methyl-1H-indole-1-butanoic acid (1d) with thionyl chloride followed by quenchings with methanol or neopentyl alcohol led respectively to (2b) $R_1 = H$; $R_3 = CH_3$ and 2c ($R_1 = H$; $R_3 = CH_2C(CH_3)_3$. The structural proof of (2) rests on its ^1H and ^{13}CNMR data along with comparison to (3) whose synthesis and structural elucidation by x-ray and ^{13}C NMR spectroscopy have been reported. Proton-carbon coupling constants were determined by using the gated-decoupling technique. Analytical calculations were found for $C_{15}H_{15}NO_5$; $C_{13}H_{13}NO_3$; $C_{16}H_{13}NO_5S$; $C_{14}H_{11}NO_3S$; and $C_{18}H_{19}NO_3S$. 1 table. (DP)

8929 Spherands-ligands whose binding of cations relieves enforced electron-electron repulsions. Cram, D.J. (Univ. of California, Los Angeles); Kaneda, T.; Helgeson, R.C.; Lein, G.M. Contract AT(04-3)34. *J. Am. Chem. Soc.;* **101**: No. 22, 6752-6754(24 Oct 1979).

A new series of ligands called spherands are similar to the crowns and cryptands. However, the cavity formed by the oxygen shell can be occupied only by spherical entities such as single atoms or monatomic ions. A cyclohexamato phenylene system provides a framework which holds the oxygen of 6 methoxyl groups in a perfect octahedral arrangement by their attachment to the six convergent positions of the aryl groups. Ligand complexes with lithium and sodium as cations and $FeCl_4$, chlorides, perchlorates and bromides as anions were prepared; their thermal stabilities were examined; and their NMR spectra were analyzed. The structures of the compounds are discussed.

8930 Representation of vapor-pressure data. Scott, D.W.; Osborn, A.G. (Department of Energy, Bartlesville, OK). *J. Phys. Chem.;* **83**: No. 21, 2714-2723(18 Oct 1979).

Two equations are proposed for representing vapor-pressure data, one for the entire liquid range and the other for a limited temperature range. Their use is illustrated with selected sets of experimental vapor-pressure data. Each of these equations is shown to have definite advantages over some alternative equations used heretofore. Their use in detecting inconsistent data is emphasized. Original vapor-pressure data are reported for liquid benzene and solid hexafluorobenzene. 5 figures, 4 tables.

8931 Reactions of benzaldehyde with trialkylsilyl metal carbonyl complexes. Johnson, D.L.; Gladysz, J.A. (Univ. of California, Los Angeles). *J. Am. Chem. Soc.;* **101**: No. 21, 6433-6435(10 Oct 1979).

The use of trialkylsilyl metal carbonyl complexes as reagents for organometallic synthesis was investigated. In this communication it was reported that the metal silanes $(CO)_5MnSi(CH_3)_3$(1), $(CO)_4Fe[SiCH_3)_3]_2$(2), and $(CO_4)FeSi(CH_3)_2(CH_2CH_2Si(CH_3)_2$(3) undergo reactions with benzaldehyde which result, under appropriate conditions, in the formation of α-silyloxybenzyl- and benzylidene-derived ligands. It was reported that a strongly oxygenophilic group must be present on manganese in order for a benzaldehyde adduct to be detectably formed. The catalytic hydrosilyation of aldehydes and ketones has been postulated to involve a similar carbonyl group addition by a catalytically active L/sb n/M(H)SiR_3 species. The presence of chelating disilane ligand enables the chemistry of 3 to dramaticaly diverge from that of 2. With aliphatic aldehydes and ketones, 1 and 2 react differently. (DP)

8932 Correlation between the solubility of aromatic hydrocarbons in water and micellar solutions, with their normal boiling points. Almgren, M.; Grieser, F.; Powell, J.R.; Thomas, J.K. (Univ. of Notre Dame, IN). *J. Chem. Eng. Data;* **24**: No. 4, 285-287(Oct 1979).

A linear correlation between the logarithm of the solubility in water of aromatic hydrocarbons and their normal boiling points is shown. Similarly, the logarithm of the distribution ratio of aromatic hydrocarbons in aqueous micellar solution is shown to be linearly related to the boiling points of the hydrocarbons. 2 figures, 2 tables.

8933 Adsorption of aliphatic acids from aqueous solutions onto activated carbon. Wang, S.W.; Hines, A.L.; Farrier, D.S. (Colorado School of Mines, Golden). *J. Chem. Eng. Data;* **24**: No. 4, 345-347(Oct 1979).

The radioisotope technique was applied to study the removal of aliphatic acid contaminants found in byproduct waters of fossil fuel conversion processes at three different temperatures. Five pure component systems (acetic acid, propionic acid, n-butyric acid, n-hexanoic acid, and n-heptanoic acid) were investigated at three different temperatures, 278, 298, and 313°K, by using activated carbon as the adsorbent. The results were modeled by a three-parameter adsorption isotherm equation. 3 figures, 6 tables.

8934 Temperature-induced variation in the intrinsic hyperfine separation of a tightly bound nitroxide spin label. Johnson, M.E. (Univ. of Illinois Medical Center, Chicago). *FEBS (Fed. Eur. Biochem. Soc.) Lett.;* **97**: No. 2, 363-366(Jan 1979).

Recently there has been increasing interest in studying the rotational motion of biological molecules by monitoring the electron paramagnetic resonance (EPR) spectra of spin labels which are tightly bound to the molecule of interest. Theoretical studies have shown that in the slow motion region the correlation time may be determined by comparing the apparent hyperfine separation (HFS) in the presence of rotational motion with the rigid limit HFS in the absence of rotational motion. The majority of work to date has assumed the tightly bound nitroxide label to act simply as a reporter group for molecular motion, exhibiting little or no intrinsic environmental or temperature sensitivity. However, we have demonstrated that the rigid limit EPR spectra exhibit a substantial intrinsic temperature dependence, with the rigid limit HFS of MAL-6-labelled carboxyhemoglobin (HbCO) decreasing by nearly 10G over the temperature range -196°C to +45°C. The steepest temperature dependence was also found to occur over the 0 to 40°C temperature range where most biological measurements are made. This strong temperature dependence in the intrinsic HFS was shown to produce substantial errors in correlation time calculations if it was not explicitly recognized and appropriate corrections made. This detailed behavior of this intrinsic temperature dependence suggests that it is most probably produced by equilibrium hydrogen bonding between the nitroxide NO/sup ./ group and an unidentified proton donor within the spin label binding site. (RJC)

8935 Crystal structure of 2-fluoro-1,3-dimethyl-1,3,2-diazaphospholidine 2-sulfide. Light, R.W. (Univ. of New Mexico, Albuquerque); Campana, C.F.; Paine, R.T.; Morosin, B. Contract AT(29-1)-789. *Acta Crystallogr., Sect. B;* **34**: 3671-3674(1978).

The structure of $CH_3NCH_2CH_2N(CH_3)PF(S)$ has been determined by single-crystal x-ray diffraction techniques. This compound crystallizes with four molecules in a monoclinic unit cell of $P2_1/c$ symmetry and of dimensions a = 10.213 (6), b = 6.418 (3), c = 12.829 (6) A, and β = 103.66 (6)°. The structure was solved by direct methods and refined by full-matrix least-squares techniques to an unweighted residual of 0.048 for 734 independent diffractometer-collected reflections with $I \geq 3\sigma(I)$. The P atom of this molecule is bonded to a F atom, a S atom and two N atoms of the dimethylethylenediamine backbone. The five-membered ring contains P-N bond distances of 1.613 (5) and 1.603 (6) A with both N atoms lying in a plane defined by the three N-atom substituent groups. The P-S and P-F bond distances are 1.901 (3) and 1.560 (6) A, respectively. 2 figures, 5 tables.

8936 Synthesis of the fluorescence probe, 12-(1-pyrenyl)dodecanoic acid. Katusin-Razem, B. (Univ. of Notre Dame, IN). *Croat. Chem. Acta;* **51**: No. 2, 163-166(1978).

The synthesis of the fluorescence probe, 12-(1-pyrenyl)dodecanoic acid, was accomplished by the Wittig reaction between 1-pyrenecarboxalehyde and 10-methoxycarbonyldecyltriphenylphosphonium bromide, followed by

hydrogenation of the unsaturated product and hydrolysis of methyl ester. The Wittig reaction was carried out with sodium methoxide in dimethylformamide, at room temperature and under a N_2 atmosphere. This reaction yielded a mixture of 53% trans and 47% cis isomers of 12-(1-pyrenyl)-11-dodecenoate, as determined by pulsed Fourier transform NMR technique.

8937 Enthalpies of hydrogen bonding of quinoline with o-phenylphenol and of hydrogen-bonding reactions involving the acid and base components of a coal-derived asphaltene. Dietz, A.G.; Blaha, C.; Li, N.C. (Duquesne Univ., Pittsburgh, PA). Contract EY-76-S-02-0063. *J. Chem. Thermodyn.;* **9**: 783-787(1977).

Calorimetric studies are reported of hydrogen bonding between quinoline (Qu) and o-phenylphenol (OPP). The enthalpies of hydrogen-bonding of the acid and base components of a coal-derived asphaltene with OPP and Qu are also reported. The results provide strong evidence that the acid and base components of asphaltene function substantially as hydrogen donor and acceptor, respectively. 1 figure, 1 table.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 8917

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

8938 (LA-UR—79-3357) **Carbon isotope separation by absorptive distillation.** Mills, T.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 31p. (CONF-7910108—1). Dep. NTIS, PC A03/MF A01.

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

The feasibility of separating carbon isotopes by absorptive distillation has been studied for CO absorption by cryogenic solvents. Phase equilibrium, isotopic separation, and mass transfer data were taken between 77.4 and 114.3 K for the following solvents: propane, propylene, 1:1 propane-propylene, 1-butene, isobutane and nitrogen. Carbon monoxide solubility followed Henry's Law, with a maximum experimental solubility of 6.5 mole percent. Isotopic separation between CO in the gas and liquid phases using hydrocarbon solvents was several times that for pure CO vapor-liquid equilibrium. The maximum observed isotopic separation factor was 1.029 at 77.4 K with the propane-propylene solvent mixture. Mass transfer measurements yielded calculated HETP's of 2 to 5 cm for a possible separation system. An attempt has been made to correlate isotopic separation data using Hildebrand's theory of solutions. The differential absorption of isotopic CO species is expressed as a difference in solubility of the isotopic CO molecules. Data for propane, propylene, and 1-butene show approximately the same behavior at varying temperatures.

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 8285, 9275

8939 (DOE/ER/10396—1) **Studies of free radicals by ultraviolet excimer laser photolysis. Progress report, April 1-November 1, 1979.** Leone, S.R. (Colorado Univ., Boulder (USA)). 1979. Contract AC02-79ER10396. 13p. Dep. NTIS, PC A02/MF A01.

An experimental technique has been developed to produce and directly study vibrationally excited free radicals. Pulses of light from an ultraviolet excimer laser are used to photodissociate small molecules to generate free radicals with high internal excitation. The radicals are detected directly by the technique of time and wavelength-resolved infrared emission spectroscopy using a background-limited copper-doped germanium infrared detector. The detailed kinetics of rapid vibrational deactivation and spectroscopy of the highly excited CH_2I radical have been obtained. A new technique to study chemical chain reactions using low power, radical-specific, laser initiation and realtime kinetics detection has been demonstrated. The results provide a general method to study a large number of chain reaction combustion systems in greater detail.

8940 Pressure and temperature dependence kinetics study of the NO + BrO → NO_2 + Br reaction. Implications for stratospheric bromine photochemistry. Watson, R.T. (California Inst. of Tech., Pasadena); Sander, S.P.; Yung, Y.L. *J. Phys. Chem.;* **83**: No. 23, 2936-2944(Nov 1979).

The flash photolysis-ultraviolet absorption technique has been utilized to study the reactivity of nitric oxide with BrO radicals over a wide range of pressure (100 to 700 torr) and temperature (224 to 398 K). Pseudo-first-order conditions were used in order to minimize complications caused by secondary kinetic processes. The reaction and its corresponding Arrhenius expression in units of cm^3 molecule^{-1} s^{-1} can be written NO + BrO → NO_2 + Br, ΔH_{298}^0 = -17.0 kcal mol^{-1}, $k_1 = (1.28 +- 0.23) \times 10^{-11} \exp((181 +- 46)/T)$ (T = 224 to 398°K). The results are compared with previous measurements, and atmospheric implications of the reaction are discussed. It is shown that this reaction is important in controlling the ratios [BrO]/[Br] and [BrO]/[HBr] in the stratosphere but that it does not affect the catalytic efficiency of BrO/sub x/ in ozone destruction.

8941 (LBL—9781) **Vibrational-rotational excitation: chemical reactions of vibrationally excited molecules.** Moore, C.B.; Smith, I.W.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 38p. (CONF-790411—2). Dep. NTIS, PC A03/MF A01.

From Faraday general discussion No. 67 "Kinetics of State-Selected Species"; Birmingham, UK (9 Apr 1979).

This review considers a limited number of systems, particularly gas-phase processes. Excited states and their preparation, direct bimolecular reactions, reactions of highly excited molecules, and reactions in condensed phases are discussed. Laser-induced isotope separation applications are mentioned briefly. 109 references. (DLC)

8942 (SAN—0034-240-T2) **Photo induced electron transfer reactions in mixed organic-inorganic systems. Final report.** Hammond, G.S. (Allied Chemical Corp., Morristown, NJ (USA). Corporate Research Center). 12 Sep 1979. Contract EY-76-S-03-0034-240. 6p. Dep. NTIS, PC A02/MF A01.

Fluorescence quenching of N-methyl-acridinium and triphenyl pyranium cations by metal ions (Fe, Cu, Ni) was studied. The fluorescence of both cations is quenched by metal ions, but reactivities in quenching do not correlate uniquely to the oxidation potentials of the metal cations.

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 8205, 8892, 9319

8943 (UCRL—52727) **Density and radiolytic decomposition of plutonium nitrate solutions.** Maimoni, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

The available literature data on the density and radiolytic decomposition of plutonium nitrate solutions have been carefully reviewed to obtain correlations useful for design purposes. The density is correlated for plutonium concentrations to 480 g/l, for nitric acid concentrations to 4.3N, and for temperatures to 60°C, with a standard deviation of 0.08%. Radiolysis gas evolution rates from Pu(IV) and Pu(VI) solutions were examined; while the data are not as self-consistent as those for density, the correlations are useful for nitric acid concentrations to 15N. 3 figures, 4 tables.

8944 Graft polymerization of acrylamide and 2-acrylamido-2-methylpropanesulfonic acid onto starch. Fanta, G.F.; Burr, R.C.; Doane, W.M. (Dept. of Agriculture, Peoria, IL). *J. Appl. Polym. Sci.;* **24**: No. 9, 2015-2023(1 Nov 1979).

Mixtures of acrylamide and 2-acrylamido-2-methylpropanesulfonic acid ($AASO_3H$) were graft polymerized onto starch by cobalt-60 irradiation, and the water absorbency and water solubility of the resulting products were determined. The conversion of monomers to polymer was nearly quantitative under simultaneous irradiation conditions. Products with high water absorbency were obtained with equal weights of starch and total monomers when acrylamide:$AASO_3H$ ratios ranged from 9:1 to 1:3. Water solubility of these polymers was over 50%. Neither of the two monomers gave absorbent polymers when graft polymerized individually onto starch. Although highly absorbent products were also obtained at a total monomer:starch ratio of 2:5, ratios of 1:5 and lower gave products with poor absorbency. Neutralization of $AASO_3H$ with sodium hydroxide before graft polymerization drastically reduced both the water solubility and absorbency of the final products. To obtain good water absorbency from granular starch, it was necessary to first neutralize the $AASO_3H$ portion with alkali, then disperse the polymer in hot water, and finally dry the resulting water dispersion. Graft copolymers with good water absorbency were also obtained by adding preirradiated starch to a water solution of acrylamide and $AASO_3H$, although only partial conversions of monomers to polymer were realized.Selected products from the various graft polymerizations were fractionated by extraction with either water or a 1% solution of sodium chloride. The synthetic polymer content of the resulting fractions and the percentage of $AASO_3H$ in the synthetic portion of each polymer were determined. The anti M/sub n/ of some of the synthetic polymers was also determined after removal of carbohydrate by enzymatic hydrolysis.

8945 Very low temperature pulse radiolysis. Protiated and perdeuterated methanol glasses at 6 K. Perkey, L.M. (Univ. of Notre Dame, IN); Smalley, J.F. *J. Phys. Chem.;* **83**: No. 23, 2959-2964(Nov 1979).

Spectra resulting from the pulse radiolysis of glasses CH_3OH and CD_3OD at 6 K were observed. The absorption maxima of these

spectra (625 nm for CH_3OH and 720 nm for CD_3-OD-observed 100 ns after the beginning of the electron pulse) are only slightly red shifted from the absorption maximum obtained when either of these alcohols is γ irradiated at 4.2 K (i.e., 600 nm). Bleaching studies indicate that these γ radiolysis spectra are composed of a visible part which is due to solvated electrons and an infrared part which is due to trapped electrons. The infrared portions of the pulse radiolysis spectra at 6 K are enhanced compared to the above γ radiolysis spectra, and they decay to the latter spectra by a process which is approximately first order. Benzyl chloride also reduces the infrared absorptions which are produced by an electron pulse at 6 K more effectively than it reduces the visible absorptions. The species which is responsible for the transient infrared absorption at 6 K is tentatively identified as an electron localized in either a very shallow trap or a trap which is geminate to its parent cation. In either case, since these pulse radiolysis spectra are fully developed immediately after the electron pulse, it is concluded that electrons are localized in preexisting potential wells which may be either deep or shallow in vitreous methanol.

8946 Red shift of the spectrum of solvated electrons formed near geminate ions. van Leeuwen, J.W.; Straver, L.H.; Nauta, H. (Univ. of Utrecht, Netherlands). *J. Phys. Chem.;* **83**: No. 23, 3008-3011(Nov 1979).

Spectra of solvated electrons in an 8 M NaOH glass between 4.2 and 80 K have been measured. A theory is presented which can explain the decay of absorption on the red side of the absorption maximum of solvated electrons formed instantaneously after pulse radiolysis in polar glasses. The presence of a positive geminate ion near a solvated electron will cause a red shift of the spectrum; the closer the solvated electron is to the geminate ion, the larger the shift. Recombination will then cause a decay on the red side of the absorption maximum of the solvated electron. A formula is derived for the radius around a positive geminate ion within which no solvated electrons can be formed.

8947 Neutron-capture prompt γ-ray activation analysis for multielement determination in complex samples. Failey, M.P. (Univ. of Maryland, College Park); Anderson, D.L.; Zoller, W.H.; Gordon, G.E.; Lindstrom, R.M. Contract EY-76-S-05-5173. *Anal. Chem.;* **51**: No. 13, 2209-2221(Nov 1979).

Gamma-ray spectra were taken up to 11 MeV from a wide range of samples and elemental standards while under neutron irradiation to determine the elements whose prompt γ rays are observable and can be used for analytical measurement. Up to 17 elements from among the set H, B, C, N, Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Mn, Fe, Cd, Nd, Sm, and Gd are measurable in samples of coal, fly ash, orchard leaves, and bovine liver by neutron-capture prompt γ-ray activation analysis (PGAA). The combination of PGAA and instrumental neutron activation analysis (which uses the same equipment) can be used to measure concentrations of 40 to 50 elements in individual samples of many types of material. Concentrations are reported for the elements measurable by PGAA in National Bureau of Standards Standard Reference Materials: coals (SRMs 1632, 1632a, 1635), fly ashes (1633, 1633a), orchard leaves (1571), and bovine liver (1577). 9 figures, 6 tables.

8948 Fluorescence and proton nuclear magnetic resonance studies of thallous ions - crown ether complexes in organic solvents. Platzner, T. (Univ. of Notre Dame, IN); Thomas, J.K.; Graetzel, M. *Z. Naturforsch., b;* **338**: 614-618(1978).

The complexing of thallous ions (Tl^+), with the crown ether dibenzo 18 crown-6 polyether (DB) has been studied by NMR, fluorescence, and pulse radiolysis techniques. NMR data show a strong interaction of the Tl^+ ions with the aromatic moieties. This is also illustrated by a static quenching of the aromatic fluorescence by Tl^+. The rates of reactions of Tl^+ with hydrated electrons e/sub aq/- and pyrene excited singlet states are decreases on complexing the ion by the crown ether.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

HOT-ATOM CHEMISTRY

8949 Direct synthesis of oxygen-15 labelled water at high specific activities. Ruiz, H.V.; Wolf, A.P. (Brookhaven National Lab., Upton, NY). *J. Labelled Compd. Radiopharm.;* **15**: 185-189(1978).

Oxygen-15 labelled water has been prepared at high specific activities (> 100 mCi/ml) by nuclear recoil techniques available for use after 1 min from EOB. Radiogenic oxygen-15 atoms generated in a cyclotron by the $^{14}N(d,n)^{15}O$ reaction, are allowed to react directly with molecular hydrogen in the gas phase to produce labelled carrier-free $H_2{}^{15}O$ which can be used for biomedical purposes. 1 table.

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 8135, 8177, 8943

8950 Anion-exchange column chromatography of EDTA, DTPA, and the DTPA complexes of calcium and plutonium. Bhattacharyya, M.H.; Peterson, D.P. (Argonne National Lab., IL). *Radiat. Res.;* **80**: No. 1, 208-213(Oct 1979).

An anion-exchange column system is described which is capable of separating ethylenediaminetetraacetic acid (EDTA) from diethylenetriaminepentaacetic acid (DTPA) in the form of their calcium chelates. In addition, distinct elution positions are demonstrated for: (1) the unchelated form of DTPA; (2) the calcium chelate of DTPA; and (3) the plutonium(IV) chelate of DTPA. Preparation and chromatograhy of a doubly labeled complex of ^{239}Pu(IV) and ^{14}C-labeled DTPA ([^{14}C]DTPA) are also described. Separation of [^{14}C]DTPA from autoradiolytic breakdown products found in high-specific-activity preparations is demonstrated. This chromatograhic procedure has the potential for use in studying the metabolism and mechanism of action of DTPA and for evaluating the purity of [^{14}C]DTPA preparations.

8951 Hydrogen uranyl phosphate tetrahydrate, a hydrogen ion solid electrolyte. Morosin, B. (Sandia Labs., Albuquerque, NM). Contract AT(29-1)-789. *Acta Crystallogr., Sect. B;* **34**: 3732-3734(1978).

$HUO_2PO_4.4H_2O$, P4/ncc, a = 6.995 (2), c = 17.491 (4) A, Z = 4, V = 855.84 A^3, D/sub c/ = 3.399 g cm^{-3}. The structure has been refined using 695 Mo Kα (λ = 0.710688 A, μ = 166 cm^{-1}) intensities to R = 0.025. The two-dimensional network of hydrogen bonds serves as the path for H^+ ion conduction in this material. 1 figure, 1 table.

RADIOISOTOPE PRODUCTION

8952 Preparation of carrier-free ^{47}Sc by the $^{47}Ti(n,p)$ reaction with epithermal neutrons. Gladney, E.S.; Goode, W.E. (Los Alamos Scientific Lab., NM (USA)). *Int. J. Appl. Radiat. Isot.;* **30**: No. 1, 65(Jan 1979).

8953 Method of producing radioactive technetium-99M. Karageozian, H.L. US Patent 4,158,700. 19 Jun 1979. Filed date 14 Mar 1978. 8p.

A chromatographic process of producing high purity and high yield radioactive Technetium-99m. A solution containing Molybdenum-99m and Technetium-99m is placed on a chromatographic column and eluted with a neutral solvent system comprising an organic solvent and from about 0.1 to less than about 10% of water or from about 1 to less than about 70% of a solvent selected from the group consisting of aliphatic alcohols having 1 to 6 carbon atoms. The eluted solvent system containing the Technetium-99m is then removed leaving the Technetium-99m as a dry, particulate residue.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

REFER ALSO TO CITATION(S) 8859

8954 (COO—4650-1) **Research in nonlinear problems of energy. Progress report, November 1, 1977-October 31, 1979.** Matkowsky, B.J. (Northwestern Univ., Evanston, IL (USA)). Dec 1979. Contract ER-78-S-02-4650. 5p. Dep. NTIS, PC A02/MF A01.

A research program in the applications of Bifurcation and Stability Theory to Problems of energy is described with specific emphasis on Problems of Combustion and Flame Propagation. In particular, the transition from laminar to turbulent flame propagation is considered.

8955 (DOE/NASA/2593—79/10) **Analytical study of nitrogen oxides and carbon monoxide emissions in hydrocarbon combustion with added nitrogen: preliminary results.** Bittker, D.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1980. Contract EF-77-A-01-2593. 17p. (NASA-TM—79296; CONF-800302—1). Dep. NTIS, PC A02/MF A01.

From 25. international gas turbine conference; New Orleans, LA, USA (9 Mar 1980).

Objective is to analytically determine the effect of combustor operating conditions on the conversion of fuel-bound nitrogen (FBN) to nitrogen oxides (NO/sub x/. The effect of FBN and of operating conditions on carbon monoxide (CO) formation was also studied. For these computations, the combustor was assumed to be a two-stage, adiabatic, perfectly-stirred reactor. In the first computation, propane-air was used as the combustible mixture and fuel-bound nitrogen was simulated by adding nitrogen atoms to the mixture. The oxidation of propane and formation of NO/sub x) and

CO were modeled by a fifty-seven reaction chemical mechanism. Results are reported in this paper for NO/sub x/ and CO formation as a function of primary and secondary stage equivalence ratios and residence times as well as the amount of FBN in the unburned mixture. Comparison of the computed results with experimental data obtained under another part of the CRT program is also shown.

8956 (PB—295500) **Influence of aerodynamic phenomena on pollutant formation in combustion. phase ii. liquid fuels. Final report August 76-October 77.** Spadaccini, L.J.; McVey, J.; Kennedy, J.; Kesten, A.S.; Owen, F.K. (United Technologies Research Center, East Hartford, CT (USA)). Jan 1979. Contract EPA-68-02-1873. 231p. NTIS PC A11/MF A01.

The report gives results of an experimental investigation of the effects of the interaction between physical and chemical processes on pollutant formation and destruction in a liquid-fuel, turbulent-diffusion flame burner. The effects of fuel type, inlet air swirl, inlet air temperature, and combustor pressure on the spray characteristics and the time-mean and fluctuating flow field structure were determined, using probing and optical techniques. Changes in the spray and flow field structure were correlated with changes in pollutant emissions from the burner. The investigation showed that varying these operating parameters produces major changes in spray dynamics, vaporization rates, and time-averaged fuel/air distribution within the burner which significantly influence energy release rates and pollutant formation and destruction. Significant differences were found between the mean velocities of the gas and fuel droplets which likely influence droplet vaporization rates and mixing of the vaporized fuel and air.

ENGINEERING

FACILITIES AND EQUIPMENT

8957 (CONS—2771-T2) **Development of automated welding process for field fabrication of thick walled pressure vessels. Fourth quarter technical progress report for period ending September 30, 1979.** (Westinghouse Electric Corp., Tampa, FL (USA). Tampa Div.). 1979. Contract EF-78-C-01-2771. 34p. Dep. NTIS, PC A03/MF A01.

Progress in developing an automated welding process for the field fabrication of thick walled pressure vessels is reported. Plans for the demonstration facility, for nondestructive testing, and for the procurement of materials are discussed. (LCL)

8958 (EGG-ISSS—5020) **Conceptual guidelines to the optimal design of complex systems.** Rasmuson, D.M.; Griffith, J.M.; Wagner, D.P. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1979. Contract EY-76-C-07-1570. 35p. Dep. NTIS, PC A03/MF A01.

The report is intended to focus attention on methods or concepts to be used by designers to achieve an optimal design of complex systems. Generic aspects of the optimal system design are presented including component redundancy, diversity, separation, and isolation. Results of an analytical investigation of component redundancy in three specific design options of a shutdown heat removal system and its effect on unavailability are also presented.

8959 (LA—8101-M) **Heat pipe computer program (HTPIPE) user's manual.** Prenger, F.C. Jr. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 45p. Dep. NTIS, PC A03/MF A01.

Program HTPIPE is a hydrodynamic model of heat pipe performance. The program was developed for high-performance liquid metal heat pipes but can easily be adapted to other working fluids if thermal transport property values are known. Several liquid return geometries can be analyzed including homogeneous wick, screen covered grooves, circular arteries and gutters. The program can be used to optimize the heat pipe design, to calculate performance limits, and to determine axial temperature and pressure profiles. The program is written in FORTRAN and is operational on CDC-6000 series computers. Sample problems are included.

8960 (LA-UR—79-3353) **Plans for miniature machining at LASL.** Rhorer, R.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. (CONF-7910109—1). Dep. NTIS, PC A02/MF A01.

From Meeting of the IMOG machine tool subgroup; Oak Ridge, TN, USA (24 Oct 1979).

A special shop for making miniature or very small parts is being established within the LASL Shop Department, and one of the machine tools for this shop is a high precision lathe. The report describes a method based on scale modeling analysis which was used to define the specific requirements for this lathe.

8961 (UCRL—83663) **Selecting personnel to work on the interactive graphics system.** Norton, F.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Nov 1979. Contract W-7405-ENG-48. 12p. (CONF-791146—1). Dep. NTIS, PC A02/MF A01.

From 2. symposium on automation technology in engineering drawing; Monterey, CA, USA (13 Nov 1979).

The paper established criteria for the selection of personnel to work on the interactive graphics system and mentions some of human behavioral patterns that are created by the implementation of graphic systems. Some of the social and educational problems associated with the interactive graphics system will be discussed. The project also provided for collecting objective data which would be useful in assessing the benefits of interactive graphics systems.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 8563, 8564, 8565, 8566, 8567, 8568, 8569, 8570, 8571, 8742, 8743, 9009, 9514, 9516, 9517, 9518, 9519, 9522, 9523

8962 **Applications of cryogenic technology. Volume 7.** Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978). 408p. (CONF-780595—).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

These proceedings contain a keynote address, To Explore Future Energy Resources, and 24 technical papers. Separate abstracts were prepared for 16 of these technical contributions; the remaining 8 have already been processed for the TIC data base, and can be located by reference to the report number CONF-780595—. (RWR)

8963 **Application of superconductive electronic technology to low-frequency communications and surveillance systems.** Nisenoff, M. (Naval Research Lab., Washington, DC). pp 237-255 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

Electromagnetic radiation with frequencies below the HF (3 to 30 MHz) Band can propagate around the earth and, therefore, is commonly used for world-wide communications, for ship-to-shore links and for navigational systems. The skin depth of any conductor for electromagnetic radiation increases with decreasing frequency. Since the sea water is a conductor the lower end of this frequency region is also used by the Navy for communications with submerged submarines. The phenomena of superconductivity, occurs in a large number of metals and alloys when they are cooled to temperatures approaching absolute zero. Several properties of the superconducting state which can be used to build electric circuit elements are described. Several examples of how such elements can be employed in low-frequency systems of interest to both the military and civilian communities are given and, finally, a brief outline of the cryogenic refrigeration requirements for superconductive electronic systems is presented. (TFD)

8964 **Applications of superconductivity to high-frequency communications.** Welker, N.K.; Bedard, F.D. (Lab. for Physical Sciences, College Park, MD). pp 256-268 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

As one looks over the needs in communications to see where superconductivity may offer needed, otherwise unobtainable, performance, several general features become evident. In analog applications, the frequency domain below 30 MHz provides opportunities for filtering of signals and for signal reception. The region above ~ 30 MHz is adequately supported by conventional, room temperature technology until one reaches frequencies above ~ 10 GHz. Then, superconductive devices offer significant performance advantages to once again merit the use of etyogenic cooling. With regard to digital devices, that is computers, signal processors, analog-to-digital converters, superconductivity offers great potential in communications at all frequencies. The paper highlights the performance features and indicates where the technology may be applied in the microwave and digital areas. (TFD)

8965 **Space applications of superconductivity.** Silver, A.H. (The Aerospace Corp., Los Angeles, CA). pp 269-287 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The application of superconductivity to space systems, either military or civil, does not exist today. In fact the present use of superconductivity outside of the research laboratory is insignificant.

Therefore the paper clearly looks to the future, to potential applications of superconductivity. Such applictions are identified, the probability of implementation will depend on competition with more conventional technology. In specific applications superconductivity will significantly outperform conventional technology. A key problem for all systems applications of superconductivity, but especially for space, is cryocooling. This is a critical need which requires special attention and emphasis. (TFD)

8966 **Electric ship-propulsion transmissions.** Levedahl, W.J. (Department of the Navy, Annapolis, MD). pp 288-292 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The development of superconducting generators and motors for ship propulsion is briefly discussed. (TFD)

8967 **Air Force applications of lightweight superconducting machinery.** Oberly, C.E. (Wright-Patterson Air Force Base, Dayton, OH). pp 293-334 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The development and performance of superconducting alternators, MHD superconducting magnets, and superconducting materials are briefly described. (TFD)

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 8136, 8518

8968 (LA-UR—79-3276) **Building control for nuclear materials R and D facility.** Hart, O. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 10p. (CONF-791218—2). Dep. NTIS, PC A02/MF A01.

From 6. annual conference of the data general users group; New Orleans, LA, USA (4 Dec 1979).

The new plutonium research and development facility at LASL was the first facility to be completed in the United States under the new environmental requirements. To insure that these new requirements are met, a redundant computer system is used to monitor and control the building. This paper describes the supervisory control and data acquisition system that was implemented to perform that function.

8969 (ZJE—221) **Semiiterative method of computing the generalized perturbation weight function.** Svarny, J. (Skoda, Plzen (Czechoslovakia). Zavod Vystavba Jadernych Elektraren). 1978. 17p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The possibilities are investigated of using the semiiterative method for solving the inhomogeneous equation for the generalized perturbation weight function of a critical system. A theoretical and numerical comparison with the usual power iteration method is performed. The semiiterative method should be preferred because of the possibility it gives to accelerate the iterative process.

SHIPPING CONTAINERS

8970 (EGG-PR-T—79-012) **ETR fuel element shipping container addendum to PR-T-79-011 (TR-466). Internal technical report.** Smith, M.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 7 Aug 1979. Contract EY-76-C-07-1570. 22p. Dep. NTIS, PC A02/MF A01.

In July, 1979, EG and G Idaho, Inc. was requested to evaluate the ETR Fuel Element Shipping Container for compliance with existing transport regulations, in order to ship GETR fuel elements from Vallecitos, California to the INEL. Technical report PR-T-79-011 (TR-466), ATR Fuel Element Shipping Container Safety Analysis, was used as a basis for this evaluation. The safety analysis contained in technical report PR-T-79-011 (TR-466) was performed utilizing the ATR, ETR, MTR, and SPERT shipping containers. The report determined the ETR Fuel Element Shipping Container does comply with the existing transport regulations for a Type A quantity, Fissile Class I shipping container. The ETR and GETR fuel elements are essentially identical in physical size, construction, and fissile material content, the analysis documented in this report has determined the shipment of GETR fuel elements in the ETR shipping container to be safe and pose no threat to the public health and safety.

8971 (LA—8138-MS) **Finite element model for nonlinear shells of revolution.** Cook, W.A. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 54p. Dep. NTIS, PC A04/MF A01.

A finite element model for symmetrically loaded shells of revolution is described. The nonlinear geometric effects are accounted for by incrementing loads and iterating for equilibrium. The iteration process also allows for nonlinear materials. The shell model accounts for large strains, large rotations, and shear deformation. Three example problems demonstrate the versatility and accuracy of this model. An axially loaded cylinder and an internally pressurized spherical shell have large membrane strains, whereas a cylinder that deforms into a spherical shape has large rotations.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 8071

8972 **Cable feed-through method and apparatus for well head constructions.** Cugini, E.T. (to Shafco Industries, Inc.). US Patent 4,154,302. 15 May 1979. Filed date 31 Oct 1977. 10p.

An improved cable feed-through apparatus and method for wellheads including a unitary shell having a plurality of knock-down components therein. A plurality of parallel spaced conductors are inserted through rigid spacing and compression rings with upper and lower exposed ends for providing coupling to electric feed cables. The conductors are insulated throughout by resilient sleeves which are removably mounted in the shell. When assembled, as the shell is threaded into a hanger of a well casing head, the resilient sleeves are compressed and forced together to form a pressure-tight, insulated cable feed through device. 11 claims.

8973 **Method and equipment for drilling wells.** Konstantinovsky, M.S. US Patent 4,154,310. 15 May 1979. Filed date 27 Sep 1976. 10p.

This disclosure relates to apparatus for drilling wells for oil, gas, water, etc., wherein the device for drilling is placed in a rigid cylindrical collar which is expanded and pressed in the walls of the well. The collar absorbs a reactive torque from drilling. In the upper part of the walls of the collar control devices are installed which send up the signals about outside collar pressure, temperature, etc., and thus indicate any complications in the process of drilling. The collar is coaxially joined at its upper end to a thin-walled, continuous tube which is formed from a coiled sheet by drawing the sheet through a rolling-up system of rollers. The tube is axially extended and retracted by a mechanism which has two or more systems of tube moving elements which are symmetrically disposed relatively to a longitudinal axis of the tube and engage the external surface of the pipe column with forces which are sufficient to create the necessary friction forces for moving the tube. As the tube is extended, it draws a continuous sheet through the rolling-up system of rollers. The sheet at the time of the rolling-up embraces communication such as the pipes for feeding liquid to remove earth or rock, the electrical cable, the auxiliary flexible pipe for feeding liquid to a hydraulic cylinder, etc. During retraction, the tube is drawn through the unrolling system of rollers, unrolling it into a sheet which is wound in a coil by the winding mechanism.

LASERS

8974 (AD-A—070759) **Bibliography of Soviet laser developments. Number 33. January-February 1978.** (Defense Intelligence Agency, Washington, DC (USA)). Feb 1979. 140p. NTIS PC A07/MF A01.

This is the Soviet Laser Bibliography for January-February 1978 and is number 33 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; beam-target interaction; and plasma generation and diagnostics.

8975 (AD-A—070760) **Bibliography of Soviet laser developments. Number 34. March-April 1978.** (Defense Intelligence Agency, Washington, DC (USA)). Mar 1979. 89p. NTIS PC A05/MF A01.

This is the Soviet Laser Bibliography for March-April 1978 and is Number 34 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects: communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; beam-target interaction; and plasma generation and diagnostics.

8976 (AD-A—070761) **Bibliography of Soviet laser developments. Number 35. May-June 1978.** (Defense Intelligence Agency, Washington, DC (USA)). Apr 1979. 97p. NTIS PC A05/MF A01.

This is the Soviet Laser Bibliography for May-June 1978 and is no. 35 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; beam-target interaction; and plasma generation and diagnostics.

8977 (AD-A—070762) **Bibliography of Soviet laser developments. Number 36. July-August 1978.** (Defense Intelligence Agency, Washington, DC (USA)). May 1979. 115p. NTIS PC A06/MF A01.

This is the Soviet Laser Bibliography for July-August 1978 and is Number 36 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; beam-target interaction; and plasma generation and diagnostics.

8978 (AD-A—070763) **Bibliography of Soviet laser developments. Number 29. May-June 1977.** (Defense Intelligence Agency, Washington, DC (USA)). Aug 1978. 105p. NTIS PC A06/MF A01.

This is the Soviet Laser Bibliography for May-June 1977 and is Number 29 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; beam-target interaction; and plasma generation and diagnostics.

8979 (AD-A—070764) **Bibliography of Soviet laser developments. Number 30. July-August 1977.** (Defense Intelligence Agency, Washington, DC (USA)). Sep 1978. 80p. NTIS PC A05/MF A01.

This is the Soviet Laser Bibliography for July-August 1977 and is Number 30 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; beam-target interaction; and plasma generation and diagnostics.

8980 (AD-A—070765) **Bibliography of Soviet laser developments. Number 31. September-October 1977.** (Defense Intelligence Agency, Washington, DC (USA)). Oct 1978. 101p. NTIS PC A06/MF A01.

This is the Soviet Laser Bibliography for September-October 1977 and is Number 31 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; beam-target interaction; and plasma generation and diagnostics.

8981 (AD-A—070766) **Bibliography of Soviet laser developments. Number 32. November-December 1977.** (Defense Intelligence Agency, Washington, DC (USA)). Dec 1978. 98p. NTIS PC A05/MF A01.

This is the Soviet Laser Bibliography for November-December 1977 and is Number 32 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; beam-target interaction; and plasma generation and diagnostics.

8982 (AD-A—070823) **Tlhg laser development program. Final report, 1 February 1978-31 January 1979 on Phase 1.** Liu, C.S.; Williams, R.K.; Weaver, L.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 10 Apr 1979. Contract N00014-78-C-0131. 23p. NTIS PC A02/MF A01.

This report describes the results of an experimental study of the TlHg excimer system. A comparative evaluation of TlXe and TlHg candidates has indicated that the TlHg excimer is the most promising system for detailed study. An all-hot, sealed-off transverse discharge tube and a pressurized oven assembly have been fabricated and tested successfully. This experimental apparatus will permit the study of most metal excimer discharges at temperatures up to 1000 C and pressures up to 10 atm. Preliminary tests have shown that pulsed TlHg discharges suitable for excimer laser feasibility studies can be produced in the experimental apparatus. It is recommended that fluorescence and gain measurements of TlHg discharges proceed immediately, with laser tests to follow it warranted.

8983 (AD-A—071018) **Multiple photon pumping of molecular lasers: frequency tunable and far ir lasers. Interim report, 1 February 1978-31 January 1979.** Coleman, P.D. (Illinois Univ., Urbana (USA). Electro-Physics Lab.). Apr 1979. 75p. NTIS PC A04/MF A01.

This annual report describes research on two-photon pumping of molecular lasers operating on hot band transitions of the molecules and the associated nonlinear effects (Raman and hyper-Raman) that contribute to the gain spectrum of the molecular system. Accessing the hot bands of a molecule results in more lasing transitions that would otherwise be observed, and modifies the characteristics of the gain spectrum, i.e., the saturation, AC Stark shifts and width. Specific experiments described are: infrared-microwave pumping of NH3, infrared-infrared pumping on NH3, and hot band lasing in NH3. Ammonia has been chosen for study since absorption and laser assignments can readily be made for it.

8984 (AD-A—071023) **New lasers based on transition metal complexes. Final report, 1 October 1976-1 October 1978.** Andrews, L.; Johnson, E.; Lempicki, A. (GTE Labs., Inc., Waltham, MA (USA)). Apr 1979. Contract F49620-77-C-0015. 69p. NTIS PC A04/MF A01.

The purpose of this program has been to investigate the possibility that luminescent transition metal complexes (TM complexes) might serve as the basis for a new class of lasers tunable in the visible spectral region. At the beginning of the program, sufficient spectroscopic and photophysical data were available to permit calculation of threshold requirements for these new materials, and they were found to lie well within the range of conventional pump sources.

8985 (NTIS/PS—79/0883) **Neodymium YAG lasers (a bibliography with abstracts). Report for 1964-July 1979.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Sep 1979. 172p. NTIS PC N01/MF N01.

Federally-funded research reports on lasing of neodymium doped yttrium aluminum garnet are cited. Studies on design, fabrication, quantum efficiency, light pulses, stabilization, and testing are covered. Optical pumping, mode locking, frequency conversion, and modulation of these lasers are discussed. Laser applications such as optical communications, range finding, and tracking are included. Safety hazards and radiation damage related to neodymium YAG lasers are also covered. (This updated bibliography contains 166 abstracts, 17 of which are new entries to the previous edition.)

8986 (SAND—79-1318C) **Phoenix I: a transverse electron-beam-initiated hf laser amplifer.** Patterson, S.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 20p. (CONF-791220—1). Dep. NTIS, PC A02/MF A01.

From International conference on lasers '79; Orlando, FL, USA (17 Dec 1979).

The Phoenix I hf amplifier is operated with gas mixtures of F_2, O_2, and H_2 at total pressures in excess of 4.5 atm. The H_2-F_2 chemical reaction is initiated with a 1.5-MeV 85-kA electron beam, which has a cross-sectional area of 7.5 cm x 44 cm and which propagates transversely to the amplifier optical axis. For an electron-beam deposition density of 17 J/l-atm a chemical efficiency up to 3.6% or an intrinsic electrical efficiency up to 324% was obtained. The peak chemical efficiency and peak electrical efficiency were obtained with different gas mixtures.

8987 **Spectra of the lowest excited singlet states of rhodamine 6g and rhodamine b.** Hammond, P.R. (Lawrence Livermore Lab, Calif). *IEEE J. Quant. Electron.:* **QE-15**: No. 7, 624-632(Jul 1979).

Excited states of laser dyes were generated in solution by an intense 6 ns laser pump pulse tuned to the absorption maximum of the longest wavelength, ground state absorption band. They were interrogated by a shorter, simultaneous, monochromatic pulse of smaller diameter, concentric and collinear with the pump, having a

crossed polarization. Plots of transmission curves against intensity for the pump beams approached residual absorptions at the highest intensities. Gain or attenuation of the probe was measured throughout the region of the long wavelength absorption bands, at the 578.2 nm copper vapor laser wavelength, and for rhodamine 6G across the lasing band. Gains were determined at different probe intensities, and were extrapolated to small-signal values.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 8077, 8302, 8501, 8608, 8749

8988 (AD-A—070754) **Analysis of two-phase flow in nozzles and turbine buckets. Final report, 1 July 1978-30 April 1979.** Ritzi, E. (Biphase Energy Systems, Santa Monica, CA (USA)). 1 Jun 1979. Contract N00014-78-C-0649. 104p. NTIS PC A06/MF A01.

A one-dimensional analytical study was made of the two-phase flow of wet steam in a convergent-divergent nozzle with negligible wall friction. The liquid phase is assumed to consist of a cloud of spherical droplets, whose size is either controlled by a critical Weber number or predetermined. Nozzle geometry, phase velocities, mass flux density and local efficiencies are determined by numerical integration from the basic differential equation. The two-dimensional two-phase flow in impulse turbine buckets was also investigated. The parameters that control the deviation angle of the droplets from the gas path are identified.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 8026, 8134, 8479, 8487, 8992

8989 (HEDL-SA—1961-FP) **Facilities projects performance measurement system.** Erben, J.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 9 Oct 1979. Contract EY-76-C-14-2170. 47p. (CONF-791093—1). Dep. NTIS, PC A03/MF A01.

From Cost schedule control system conference; San Diego, CA, USA (31 Oct 1979).

The two DOE-owned facilities at Hanford, the Fuels and Materials Examination Facility (FMEF), and the Fusion Materials Irradiation Test Facility (FMIT), are described. The performance measurement systems used at these two facilities are next described. (DLC)

8990 (LA-UR—79-3071) **Interim report of the LASL nondestructive testing group.** Morris, R.A.; Bryant, L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-791098—1). Dep. NTIS, PC A02/MF A01.

From WANTO meeting; Oak Ridge, TN, USA (9 Oct 1979).

Topics discussed include: high-pressure diamond cell work; x-ray fluorescence analysis; shroud of turin; laser fusion target inspection; and scanning electron microscope. Organization charts for the M-1 group are included. (TFD)

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 8963, 8964, 8965, 8968

8991 (UCID—18310) **Engineering Research Division report on reports calendar year 1978.** Lorton, M.E. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Nov 1979. Contract W-7405-ENG-48. 52p. Dep. NTIS, PC A04/MF A01.

Each year the Engineering Research Division of the Electronics Engineering Department has issued an internal report listing of all formal publications produced by the division during the calendar year. The report for 1978 is being issued in two sections (the second section has been expanded from the former format due to a change in collection of information implemented during the calendar year 1978). The first section (covering January 1978 through June 1978) lists the titles, report numbers, authors, dates, an author index, and, when applicable, conferences or journals to which the paper was submitted. The second section (covering July 1978 through December 1978) provides, in addition to the above information, abstracts for each paper, and an appendix with keywords. Future publication reports will include abstracts and a keyword appendix for all reports. It is expected that the new format will make the publication report a more useful document.

8992 (JPRS—74319) **East Europe report: Scientific Affairs, No. 646.** 5 Oct 1979. Translation of various articles. 55p. NTIS.

This serial report contains press and radio coverage on the development of and progress in the various theoretical and applied scientific disciplines and technical fields; and the administration, structure, personnel, and research plans of leading East European scientific organizations and institutions, particularly the academies of sciences.

WASTE PROCESSING PLANTS AND EQUIPMENT

8993 (NP—24187) **Information report on SWARU.** Wheten, W.A. (Regional Municipality of Hamilton-Wentworth, Hamilton, Ontario (Canada). Dept. of Engineering). Apr 1977. 53p. Dep. NTIS (US Sales Only), PC A04/MF A01.

The operation and economics of the solid waste reduction facility at Hamilton, Ontario are discussed. This facility shreds municipal wastes, magnetically recovers ferrous materials, and incinerates the remaining material. Data are presented on plant efficiency, capital improvements, and operating costs. (LCL)

8994 (NP—24188) **Description of the plant and process at the East Hamilton Solid Waste Reduction Unit.** (Regional Municipality of Hamilton-Wentworth, Hamilton, Ontario (Canada). Dept. of Engineering). Aug 1978. 5p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The operation and principle design features of the solid waste preduction facility at Hamilton, Ontario are described. This unit, with a working capacity of 150 tons, receives and shreds solid wastes, recovers ferrous material by magnetic separation, and incinerates the remaining material to ash which has less than 10% of the original waste volume. (LCL)

8995 (NP—24196) **SWARU: Solid Waste Disposal Resource Recovery System.** (Canadian Industries Ltd., Kingston, Ontario (Canada)). [nd]. 13p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The SWARU solid waste disposal-resource recovery process is a comprehensive system which can accept garbage and wastes of all kinds and converts the constituents to their highest and best economic use. The SWARU system employs modern incineration and materials handling technology which facilitates resource recovery and ensures high thermal efficiency. All emissions from the plant - whether solid, or gaseous are stable, clean, and environmentally acceptable.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 8001, 8002, 8003, 8004, 8008, 8060, 8434, 8710

8996 (DOE/FE/2472—42) **Fluidized-Bed Combustion-Industrial Application Demonstration Projects. Battelle's multisolid fluidized-bed combustion process, end-of-phase final report.** (Battelle Columbus Labs., OH (USA)). Oct 1979. Contract EX-76-C-01-2472. 251p. Dep. NTIS, PC A12/MF A01.

Successful operation of the Subscale Experimental Unit System has been demonstrated; performance was comparable to that of the 6-inch unit (one-tenth scale), indicating that scale-up problems should be minimal. Combustion of as-received wet lump coal (e.g., 1-1/4 in. top size) has been successfully demonstrated. Combustion performance was independent of feed location; accordingly, feeding from above the dense bed is preferred because of relative simplicity of the feeding system. Comparable combustion efficiency and sulfur retention were obtained using either tan silica pebbles or hematite ore as the dense bed material. Tan silica pebbles are preferred from a cost and availability standpoint. Limestone needs to be well distributed in the dense bed to ensure effective sulfur retention. Excellent sulfur removal and limestone utilization can be achieved in the MSFBC system. Effective freeboard height was found to be one of the most important process variables affecting sulfur retention. Sulfur retention decreases with increasing limestone particle size, but is not significantly dependent on coal size, dense bed height, bed type, or excess air. Good combustion efficiency (up to 98 percent) has been demonstrated for both lump and crushed coals. Carbon recycle in the sand circulation stream and/or the flyash reinjection stream is essential to achievement of such a high overall combustion efficiency. The heat transfer coefficient for the steam tubes located in the entrained bed region ranged from 10 to 16 Btu/ft^2-hr-F (lower-than-expected). Appreciable metal wastage on boiler tubes in the entrained bed zone was observed for the sections not parallel to the flow direction.

8997 **Heat exchanger designs for coal-fired fluidized beds.** Zakkay, V.; Miller, G. (New York Univ, NY). *Proc., Intersoc. Energy Convers. Eng. Conf.*; **1**: 635-642(1978). (CONF-780801—P1).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The paper reports on studies of the performance of various heat exchanger geometries for utilization in coal-fired fluidized beds.

Vertical and horizontal configurations, both finless and with fins, have been tested. Detailed measurements of local, overall, and instantaneous (time dependent) heat transfer have been made. The local and instantaneous measurements reveal some unique features of the fluid mechanics in a fluidized bed under different operating conditions. Comparisons between deep and shallow beds have been made, and the effect of pressure on heat transfer has been studied. Results indicate a substantial increase in the film coefficient utilizing a pressurized bed for the heat exchangers tested. In addition, preliminary results indicate that deep beds may have poor fluidizing quality near the grid. A physical explanation of such results is presented.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 8448, 8804

8998 (PB—298389) **Electrostatic precipitator technology assessment: visits in Japan, November 1977. Final report, November 1977-April 1978.** Nichols, G.B. (Southern Research Inst., Birmingham, AL (USA)). Jun 1978. Contract EPA-68-02-2610. 47p. NTIS PC A03/MF A01.

The report gives results of a particulate control technology assessment visit to Japan by a team of U.S. investigators. The visit included discussions with personnel from universities, industries, and other major installations involved with particulate control. Significant research activities were noted in both the academic and industrial sectors related to particulate control and measurements. The report summarizes results of the individual discussions, observations during the tour, and discussions of technical papers.

8999 **Access for flared gas to steam in flares.** Reed, R.D.; Zink, J.S.; Schwartz, R.E. (to John Zink Co.). US Patent 4,154,572. 15 May 1979. Filed date 15 Jul 1977. 6p.

The patent describes an improved flare system in which steam is injected into the column of gas to be burned, from circumferential nozzles at at least two spaced levels, above the tip of the flare stack. A circular manifold surrounds the stack just below the tip and an even number of small diameter riser pipes are attached to the manifold, spaced equally circumferentially. The riser pipes have nozzles all of which are directed radially inwardly and upwardly at a selected angle. Half of the nozzles are spaced at a first selected distance above the tip of the flare stack, and the other half are positioned at a greater selected elevation above the tip of the flare stack. Alternate risers have different elevations of the nozzles. By this means, a minimum diameter of the cross-section of the gas flow is occluded by the steam flow.

POWER CYCLES

BRAYTON

REFER ALSO TO CITATION(S) 8306, 8438

RANKINE

9000 (DOE/SF/10538—1) **Organic Rankine Cycle Engine technology in Japan. A preliminary survey.** (Galaxy, Inc., Washington, DC (USA)). Oct 1979. Contract AC03-79SF10538. 132p. Dep. NTIS, PC A07/MF A01.

The state-of-the-art of the development of Organic Rankine Cycle Engines in Japan is reviewed. (TFD)

PARTICLE ACCELERATORS

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

9001 (LA-UR—79-3373) **Limitations of the disk-and-washer structure.** Schriber, S.O.; Potter, J.M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-790927—33). Dep. NTIS, PC A02/MF A01.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

A preliminary analysis of measurements on $\beta = 0.6$ and 1.0 disk-and-washer linac cavities has indicated some limitations on washer support methods; in particular, that the use of radial supports should be avoided until further testing is completed.

9002 **Delivery of single accelerated particles.** McNulty, P.J.; Pease, V.P. (Clarkson Coll. of Tech., Potsdam, NY (USA)); Bond, V.P. (Brookhaven National Lab., Upton, NY (USA)); Schimmerling, W.; Vosburgh, K.G. (Princeton-Pennsylvania Accelerator, Princeton, NJ (USA)); Crebbin, K.; Everette, W.; Howard, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Instrum. Methods;* **155**: No. 3, 325-329(1 Oct 1978).

It is desirable for certain experiments involving accelerators to have the capability of delivering just a single beam particle to the target area. The essential features of such a one-at-a-time facility are discussed. Two such facilities are described which were implemented at high-energy heavy ion accelerators without having to make major structural changes in the existing beam lines or substantially interfering with other accelerator uses. Two accelerator facilities are described which had the capability of delivering a single beam particle to the target area. This feature is necessary in certain experiments investigating visual phenomena induced by charged particles, other single particle interactions in biology, and other experiments in which the low intensities of cosmic rays need to be simulated. Both facilities were implemented without having to make structural changes in the existing beam lines or substantially interfering with other accelerator uses.

AUXILIARIES AND COMPONENTS

REFER ALSO TO CITATION(S) 9009, 9023

EXPERIMENTAL FACILITIES AND EQUIPMENT

9003 (LA-UR—79-3178) **RSX handler for transferring large blocks of data between tasks.** Kozlowski, T.; Oothoudt, M.; Daniels, D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 3p. (CONF-791215—2). Dep. NTIS, PC A02/MF A01.

From DECUS 1979 fall symposium; San Diego, CA, USA (10 Dec 1979).

A pseudo-device handler was written which allows the transfer of up to 64K byte blocks of data between tasks. The basic mechanism is as follows: one task issues a read QIO which references another task to which the data are to be sent. This second task issues a write QIO referencing the first task. The handler resolves the two QIO's may be issued in any sequence and with any separation in time. Such a handler is useful in an environment in which it is important to conserve active page registers and virtual address space.

9004 (LBL—9841) **Low-noise wide-band amplifier system for stochastic beam cooling experiments.** Leskovar, B.; Lo, C.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 11p. (CONF-791037—15). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

A new low-noise wide-band power amplifier system has been developed for stochastic beam cooling experiments. The system incorporates a low-noise preamplifier with a noise figure of 1.9 dB over a bandwidth range of 20 to 300 MHz, wide-band driver and buffer stages, a frequency characteristics shaping network, a remotely controlled wide-band attenuator with 0.1 dB resolution, a remotely controlled high resolution adjustable delay line, and a wide-band solid-state output power amplifier. The amplifier system has a maximum voltage gain of 140 dB over a bandwidth from 1.5 to 310 MHz, a signal group delay of 55.5 ns, and a c.w. output power level of 75 W. Particular attention was paid to minimizing the signal propagation time delay of the amplifier system, the propagation time delay change as a function of the system gain, and harmonic and intermodulation distortions. Using a new wide-band electron bombarded semiconductor output amplifier, the system will have a bandwidth from 30 to 400 MHz, a signal group delay of 37 ns and an output power of 100 W.

9005 **Large liquid-argon shower detector for an ISR experiment.** Cobb, J.H.; Iwata, S.; Raim, D.C.; Rehak, P.; Stumer, I. (Brookhaven National Lab., Upton, NY (USA)); Fabjan, C.W.; Harris, M.; Lindsay, J.; Mannelli, I.; Nakamura, K. (European Organization for Nuclear Research, Geneva (Switzerland)). *Nucl. Instrum. Methods;* **158**: No. 1, 93-110(1 Jan 1979).

A large liquid-argon shower detector system has been constructed for the detection of photons and electrons at the CERN ISR. The calorimeter system is built in a modular way such that eight modules would cover phi$=2\pi$ azimuthally with a total solid angle of $\Omega=8$ sr. Each module consists of 1.5 mm thick lead plates, spaced 2mm apart. Longitudinal grouping and transversal division into strip-like sections of the charge-collecting electrodes provides the required spatial resolution and hadron discrimination. Measurements on energy and space resolution and electron/hadron discrimination are described. The signal-processing system, designed to minimize electronics noise, can handle event rates up to 0.5 MHz and provides energy information for trigger purposes. The perform-

ance of this calorimeter system during two years of ISR operation is reported.

9006 **Bi-dimensional drift chambers at Fermilab.** Atac, M.; Urish, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Nucl. Instrum. Methods;* **156**: No. 1, 163-168(15 Oct 1978).

Bi-dimensional drift chambers up to 2 m X 1.5 m size using flexible printed circuit balanced delay lines are built. The delay line has good transmission characteristics with 85 Ω impedence and good longitudinal coordinate resolution with geometrical and constructional advantages.

9007 **Proportional wire chamber system for beam definition in precision total cross section measurements.** Carroll, A.S.; Chiang, I.H.; Kycia, T.F.; Li, K.K.; Mazur, P.O.; Michael, D.N.; Mockett, P.M.; Rahm, D.C.; Rubinstein, R. (Brookhaven National Lab., Upton, NY (USA)); Eartly, D.P. *Nucl. Instrum. Methods;* **156**: No. 1, 339-346(15 Oct 1978).

The authors have developed and extensively used a PWC system in precision measurements of total cross sections at low momenta (0.4-1.1 GeV/c) and at high momenta (23-370 GeV/c). This 'electronic collimator' operated simultaneously in a fast (250 ns) decision making mode, and a slower (0.5 ms) readout mode. The decision making mode utilized adjustable hardwired logic to define acceptable incident beam trajectories and reject multiple beam tracks. A sample of the events was read into an on-line computer for beam tuning, for chamber diagnostics, and for study of the effect of small angle scattering to verify the total cross section extrapolation procedure.

9008 **Photon dose rate from induced activity in the beam stop of a 400 GeV proton accelerator.** Alsmiller, R.G. Jr.; Gabriel, T.A.; Barish, J. (Oak Ridge National Lab., TN (USA)). *Nucl. Instrum. Methods;* **155**: No. 3, 399-406(1 Oct 1978).

Calculated results are presented of the photon dose rate from the induced activity produced in the beam stop of a high energy proton accelerator. Incident proton energies of 400 GeV, 200 GeV and 30 GeV are considered. In each case the photon dose rate is given as a function of radius in the beam stop and as a function of time after the beam is turned off for assumed operating times of 90 days and 10 years.

STORAGE RINGS

9009 **High energy physics superconducting magnets and cryogenic systems.** Rode, C.H. (Fermi National Accelerator Lab., Batavia, IL). pp 197-212 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The role of magnets in high-energy physics has changed in recent years. A quick look is first taken at some of the largest examples of pool boiling systems as exemplified in ANL, BNL, CERN, and Fermilab hydrogen bubble chambers. Then forced flow cooling as applied to three large cryogenic systems (ESCAR, ISABELLE, and TEVATRON) is discussed. 11 figures, 2 tables. (RWR)

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 9475

9010 (COO—2114-36) **Fast Filter Central Drift Chamber Program. MAC Note 404.** Ford, W.T. (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics). 24 Jul 1979. Contract EY-76-C-02-2114. 3p. Dep. NTIS, PC A02/MF A01.

A fast filter of the central detector tracking program was developed and tested. The search for tracks is conducted as in the full linking program - from the outermost layer hit to the next layer in. Any hit is accepted within a road centered which is large enough to allow for stero displacement and any curvature. With the fast filter, this is continued to the innermost layer, with five or more hits accepted as a track. (FS)

9011 (COO—2114-37) **Calibration of the inner detector. MAC-406.** Smith, J. (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics). 1979. Contract EY-76-C-02-2114. 7p. Dep. NTIS, PC A02/MF A01.

Calibration and alignment of the inner-drift chambers breaks into two tasks. Parameters necessary to extract precise spatial coordinates from raw drift times were determined. Cosmic rays were used in the initial calibration. The calibration is fairly constant over times of several months. (FS)

9012 (EGG—1183-2373) **Recalibration of P-2 standard ionization chamber.** Detch, J.L. Jr. (EG and G, Inc., Goleta (USA). Energy Measurements Group). Jun 1978. Contract EY-76-C-08-1183. 53p. Dep. NTIS, PC A04/MF A01.

Experimental and analytical techniques are described which permitted recalibration of the P-2 chamber's monoenergetic sensitivity based upon combined responses from a set of bremsstrahlung measurements, monoenergetic isotopic source measurements, and a monoenergetic gamma radiation produced by inelastic proton scattering. A novel technique is described for combining simultaneous knowledge of bremsstrahlung and monoenergetic response measurements with a statistically determined least structures constraint. The experimental details, analytical procedures, and resulting calibration of the standard P-2 ionization chamber from 100 keV to 20 MeV are presented and compared with previous determinations of the P-2 chamber sensitivity. Differences of approximately 15% between the derived sensitivity and the previously accepted values were observed in the region between 1.5 and 6 MeV.

9013 (HEDL-SA—1805-FP) **Thermal annealing studies in muscovite and in quartz.** Roberts, J.H.; Gold, R.; Ruddy, F.H. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1979. Contract EY-76-C-14-2170. 13p. (CONF-790765—3). Dep. NTIS, PC A02/MF A01.

From 10. international conference on solid state nuclear track detectors; Lyons, France (2 Jul 1979).

In order to use Solid State Track Recorders (SSTR) in environments at elevated temperatures, it is necessary to know the thermal annealing characteristics of various types of SSTR. For applications in the nuclear energy program, the principal interest is focused upon the annealing of fission tracks in muscovite mica and in quartz. Data showing correlations between changes in track diameters and track densities as a function of annealing time and temperature will be presented for Amersil quartz glass. Similar data showing changes in track lengths and in track densities will be presented for mica. Time-temperature regions will be defined where muscovite mica can be accurately applied with negligible correction for thermal annealing.

9014 (LBL—9759) **Protective surface coatings on semiconductor nuclear radiation detectors.** Hansen, W.L.; Haller, E.E.; Hubbard, G.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 8p. (CONF-791037—16). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

Surface states on germanium p-i-n junctions have been investigated using deep level transient spectroscopy (DLTS) and collimated beams of 60 keV gamma-rays. The DLTS spectra have a characteristic signature for each surface treatment but the spectra are complex and not readily interpretable as to suitability for radiation detectors. Collimated gamma-ray beams give a direct measure of surface channel effects and typeness. Hydrogenated amorphous germanium (a-Ge:H) was explored as a surface layer to adjust the electrical state and passivate the surface. Our measurements show that these layers produce flat band conditions, introduce no additional noise and appear to be stable against a variety of ambients.

9015 (LBL—9915) **Analysis of low energy beta-emitters.** Murphy, D.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 18p. (CONF-791049—22). Dep. NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

A survey was made of the instruments used for the determination of low energy beta radioactivity. Techniques commonly used are gas flow proportional counting, liquid scintillation counting, solid scintillation counting, and internal ionization chamber counting, solid state detector counting, and radiochemical separation followed by counting using one of the preceeding techniques. The first four techniques were examined and compared with each other. The sensitivities of the techniques were compared on the basis of the detection limits quoted for instruments described in the technical and reviewed literature. The detection limits were then related to the occupational and public individual maximum levels for air and water. Attention is focused primarily on the continuous monitoring of air for ^{3}H and ^{85}Kr, a medium energy β-emitter. It is clear that several continuous air monitoring instruments are readily available for measuring low energy β concentrations, even in presence of certain other activity, at occupational levels. However, these instruments do not typically have sensitivities comparable to the public individual levels. Moreover, their capabilities for giving results in

real time and for differentiating among the radionuclides actually present is limited.

9016 (NUREG/CR—1107) **Gas scintillation proportional counter for measuring plutonium in humans and the environment. Final report, July 1976-September 1979.** Palmer, H.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract EY-76-C-06-1830. 27p. (PNL—3151). Dep. NTIS, PC A03/MF A01.

The design, construction, and testing procedures for a gas scintillation proportional counter for use in measuring plutonium and other transuranic elements in the human body and the environment are described. After testing several types of counters an electron-focusing prototype counter was built which has excellent resolution and is uniformly responsive over the entire volume of the counter. The long-term reliability of the counter was checked for one year and found to be excellent. The counter has been calibrated for measuring the lung content of ^{238}Pu, ^{239}Pu, and ^{241}Am. The counting efficiency of the counter is good but the background of the counter is too high. A second low background prototype is under construction in which ultra pure materials will be used.

9017 (ORNL/TM—6926) **Experimental study of fission counter design optimization with a simplified analytical model of performance.** Valentine, K.H.; De Lorenzo, J.T.; Clay, W.T.; Pare, V.K.; Guerrant, G.C.; Burns, R.S. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 38p. Dep. NTIS, PC A03/MF A01.

Trends inferred from this study of fission counter design confirm previously known relationships between design variables and counter performance. Most important is the proved existence of an optimum electrode spacing for a specific design that increases with electrode area and decreases with gamma dose rate. The PD product also has an optimum value, with low values being limited by the presence of electronic noise and high values by enhanced gamma pileup. Conventional 50-Ω signal cables do not always provide the best performance, particularly for large-area counters that have high interelectrode capacitances and operate in high gamma background. Values as low as 16.7 Ω yield an improvement of as much as 20%. The performance of a counter closely follows the E/P versus drift velocity characteristic of its gas mixture, and is superior for fill gases having higher electron drift velocities. The optimum filter time constant of the counting channel depends on the gamma background dose rate. At low gamma levels, when electronic noise dominates, longer filter time constants give better signal-to-noise ratios. Counters with shorter collection times more effectively suppress the gamma pileup at high dose rates, and filters with higher break-frequencies process the faster pulses more effectively. Another conclusion from this study is that the usable neutron sensitivity per gram of neutron-sensitive material is a monotonically decreasing function of electrode area. These sensitivity losses can be minimized for high-sensitivity fission counters by use of neutron-sensitive material with low intrinsic alpha activity (such as electromagnetically enriched uranium), as well as by careful specification of the major design variables.

RADIATION DOSEMETERS

REFER ALSO TO CITATION(S) 9478

9018 (HEDL-SA—1815) **Advances in SSTR techniques for dosimetry and radiation damage measurements.** Gold, R.; Roberts, J.H.; Ruddy, F.H. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 16p. (CONF-791051—8). Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Solid state track recorders (SSTR) have been applied in the diverse nuclear reactor research. Two recent advances are described which possess outstanding relevance for reactor research, namely the evolvement of SSTR radiation damage monitors and the development of CR-39, a new plastic SSTR of extremely high sensitivity. Results from high fluence irradiations of natural quartz crystal SSTR are used to illustrate the concept of the SSTR radiation damage monitor. Response characteristics of CR-39 are presented with emphasis on the remarkable proton sensitivity of this new SSTR.

9019 (NVO—0410-53) **Technical evaluation of a fast neutron dosimeter.** Lantz, M.W.; Quam, W.M. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA); EG and G, Inc., Santa Barbara, CA (USA)). Nov 1979. Contract EY-76-C-08-0410. 17p. Dep. NTIS, PC A02/MF A01.

The albedo-neutron badge as used by the Reynolds Electrical and Engineering Co., Inc., at the US Department of Energy's Nevada Test Site and other locations is described. The badge, using TLD's has proven superior to other devices in terms of reliability and range of neutron energies detectable. The initial calibrations of the badge for the sources typically employed by the users of the system are provided and the equations needed to calculate an individual's dose due to exposure to these sources are listed. Laboratory tests of the badge are tabulated and the detection limit of the system is discussed.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 8525

9020 (EGG—1183-2383) **Low background Ge(Li) detector gamma-ray spectroscopy system with sample changer.** (EG and G, Inc., Goleta (USA). Energy Measurements Group). Oct 1978. Contract EY-76-C-08-1183. 30p. Dep. NTIS, PC A03/MF A01.

A gamma-ray spectroscopy system used for analysis of volume soil and vegetation samples is described. It can accept samples of up to 2 kg weight and a 970 cm^3 volume. Its primary use is in the determination of U, Th, ^{137}Cs, ^{40}K, and ^{60}Co in samples obtained during ground truth AMS surveys throughout the country. The system was calibrated using standards from the DOE New Brunswick Laboratory and from the National Bureau of Standards. Detectabilities (at 3σ) in a 1500-g sample are: 0.28 ppM Th, 0.10 ppM U, 10 pCi ^{40}K, 1.0 pCi ?^{137}Cs, and 1.0 pCi of ^{60}Co.

9021 (HEDL-SA—1782-FP) **Reactor gamma spectrometry: status.** Gold, R.; Kaiser, B.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 11p. (CONF-791051—13). Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Current work is described for Compton Recoil Gamma-Ray Spectrometry including developments in experimental technique as well as recent reactor spectrometry measurements. The current status of the method is described concerning gamma spectromoetry probe design and response characteristics. Emphasis is given to gamma spectrometry work in US LWR and BR programs. Gamma spectrometry in BR environments are outlined by focussing on start-up plans for the Fast Test Reactor (FTR). Gamma spectrometry results are presented for a LWR pressure vessel mockup in the Poolside Critical Assembly (PCA) at Oak Ridge National Laboratory (ORNL).

9022 (ORNL/CSD/TM—101) **Computer-controlled neutron time-of-flight spectrometer. Part II.** Merriman, S.H. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 54p. Dep. NTIS, PC A04/MF A01.

A time-of-flight spectrometer for neutron inelastic scattering research has been interfaced to a PDP-15/30 computer. The computer is used for experimental data acquisition and analysis and for apparatus control. This report was prepared to summarize the functions of the computer and to act as a users' guide to the software system.

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 9005, 9007, 9009

9023 (LBL—9979) **Use of a streamer chamber for low energy nuclear physics.** Van Bibber, K.; Pang, W.; Avery, M.; Bloemhof, E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 8p. (CONF-791037—17). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

A small streamer chamber has been implemented for low energy heavy ion reaction studies at the LBL 88-inch cyclotron. The response of the chamber to light and heavy ions below 35 MeV/nucleon has been examined. The limited sensitivity of light output as a function of ionization works to advantage in recording a wide variety of tracks in the same photograph whose energy loss may vary considerably. Furthermore, as gas targets are attractive for several reasons, we have investigated the suitability of Ar and Xe for use in streamer chambers.

RADIOMETRIC INSTRUMENTS

9024 (BDX—613-2102(Rev.)) **Development of a semi-automatic beta-backscatter thickness-measuring system.** Heckman, R.V. (Bendix Corp., Kansas City, MO (USA)). Jun 1979. Contract EY-76-C-04-0613. 86p. Dep. NTIS, PC A05/MF A01.

The semi-automated beta-backscatter system was evaluated to determine the overall system capability. The capability studies performed on the system indicate that the system can measure aluminum nominally 11.33 μm (450 μin.) thick on a Kapton substrate to a precision of better than 0.72 percent (one standard deviation = +- 0.0816 μm) in a time interval of 10 seconds. The report also covers various fail safe devices installed in the positioning fixture, and changes made in the system's software to facilitate operation of the system and storage of data.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 8047, 8479, 8893, 9003

9025 (CONF-791037—6) **Design and operating experience with electric systems for high rate liquid argon calorimeters.** Droege, T.F.; Hibbard, M.C.; Nelson, C.A. Jr.; Thompson, P.A.; Makdisi, Y.; Lipton, R. (Fermi National Accelerator Lab., Batavia, IL (USA); Rochester Univ., NY (USA); Minnesota Univ., Minneapolis (USA); Northwestern Univ., Evanston, IL (USA)). 1979. Contract EY-76-C-02-3000. 4p. Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

A number of experiments have been instrumented by an ADC scheme utilizing an integrated amplifier, a packaged delay line, the difference of two samples taken Before and After the signal exits the delay, and a multiplexer to a single ADC for a system. Design features, operating peculiarities, and experience to date are discussed.

9026 (ORNL/TM—7025) **Assessment of current high-temperature strain gages.** Smith, J.E. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 59p. Dep. NTIS, PC A04/MF A01.

Long-term stability tests for systematic drift and strain sensitivity (gage factor) were conducted on two types of capacitive strain gages - the Boeing differential-capacitance gage and the CERL-Planer variable gap capacitive strain transducer - and on the Ailtech SG-425 resistance gage. Results for tests of durations up to 12,000 hr are presented and compared with similar tests reported by others. The stability and repeatability of the capacitive systems were verified. In addition, two short-term investigations were made on Ailtech weldable-resistance gages to address areas of uncertainty related to special applications. Data from these tests are also presented and interpreted. Advantages and limitations of the various systems are identified, and conclusions and recommendations are presented. Descriptions of the gage systems and problems encountered in the use of capacitive gages are given in appendices.

9027 (PNL-SA—7718) **Development of Nomarski microscopy for quantitative determination of surface topography.** Hartman, J.S.; Gordon, R.L.; Lessor, D.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 25p. (CONF-790838—3). Dep. NTIS, PC A02/MF A01.

From 23. annual international symposium of the Society of Photographic Instrumentation Engineers; San Diego, CA, USA (27 Aug 1979).

The use of Nomarski differential interference contrast (DIC) microscopy has been extended to provide nondestructive, quantitative analysis of a sample's surface topography. Theoretical modeling has determined the dependence of the image intensity on the microscope's optical components, the sample's optical properties, and the sample's surface orientation relative to the microscope. Results include expressions to allow the inversion of image intensity data to determine sample surface slopes. A commercial Nomarski system has been modified and characterized to allow the evaluation of the optical model. Data have been recorded with smooth, planar samples that verify the theoretical predictions.

9028 (SAND—78-1440) **Characteristics and development report for the MC2913 G-switch.** Schildknecht, H.E. (Sandia Labs., Albuquerque, NM (USA)). Nov 1978. Contract EY-76-C-04-0789. 82p. Dep. NTIS, PC A05/MF A01.

This report concerns the MC2913, the reentry g-switch used in the Mk 4 AF and F. Presented and discussed in the report are operating principles, design intent, system requirements, component characteristics, development history, and evaluation test results.

9029 (SAND—79-2074C) **Adaptive spectral analysis technique for unbiased frequency estimation in the presence of white noise.** Thompson, P.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 10p. (CONF-791125—3). Dep. NTIS, PC A02/MF A01.

From 13. Asilomar conference on circuits, systems, and computers; Pacific Grove, CA, USA (5 Nov 1979).

An adaptive spectral analysis technique is presented for estimating the frequencies of sinusoids corrupted by white noise. This new method is an on-line implementation of a harmonic-retrieval method proposed by Pisarenko involving the minimum eigenvalue and the associated eigenvector of the covariance matrix. This eigenvector, whose components translate into frequency estimates, is sought adaptively (without explicitly evaluating the covariance matrix) using a stochastic gradient algorithm and an appropriate nonlinear parameter constraint. The method described here is closely related to an adaptive prediction-error implementation of the autoregressive or maximum entropy estimator, but it avoids the frequency bias that is characteristic of the latter when noise is present in the observed data.

9030 (SAND—79-2218A) **Behavior of silicon devices at high temperatures.** Draper, B.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 7p. Dep. NTIS, PC A02/MF A01.

Computer modelling, device redesign, and better fabrication techniques show that silicon MOSFets and Harris semiconductors may be used in down-hole instrumentation for temperatures in excess of 300°C. Performance limits for silicon devices are given. (FS)

9031 (SAND—79-2223) **Hardware implementation of a digital sensor signal processor.** Elliott, G.R. (Sandia Labs., Albuquerque, NM (USA)). Dec 1979. Contract EY-76-C-04-0789. 29p. Dep. NTIS, PC A03/MF A01.

The implementation of digital signal processing techniques in a small, fieldable microprocessor requires careful attention to precision, environmental, and availability constraints. Sandia Laboratories is presently engaged in a program for BISS to design a processor named the MILES Adaptive Digital Processor (MADP) for installation in the field to process the signals from the MILES transducer. The heavy use of multiplication and lengthy summations has dictated the selection of a 16-bit word length processor with considerable mathematical power. Year-round operation in an unprotected enclosure has forced the use of low-power, broad-temperature-range hardware. In addition, hardware has been selected which has wide use in the military community to have the advantage of a well developed system. Development of a system for deployment is underway using a 16-bit microprocessor employing I^2L technology. An overview of this program from the hardware design standpoint is presented.

9032 (SAND—79-8265) **High-speed differential track-hold digitizer.** Van Hook, A.R. (Sandia Labs., Livermore, CA (USA)). Dec 1979. Contract EY-76-C-04-0789. 24p. Dep. NTIS, PC A02/MF A01.

Obtaining accurate measurements in noisy environments or measurements with slowly varying background biases can be difficult, and at times impossible, when the background variation has a high dynamic range. Obtaining useful data with resolutions of one part in 10,000 (0.01%) in these types of environments can be simplified through the use of a differential track-and-hold system. A differential technique is described to obtain ground reference correction during real-time high-speed data collection.

9033 (SLAC-PUB—2420) **Programmable synchronous communications module.** Horelick, D. (Stanford Linear Accelerator Center, CA (USA)). Oct 1979. Contract EY-76-C-03-0515. 31p. (CONF-791153—1). Dep. NTIS, PC A03/MF A01.

From Joint AT-E division seminar; Los Alamos, NM, USA (14 Nov 1979).

The functional characteristics of a programmable, synchronous serial communications CAMAC module with buffering in block format are described. Both bit and byte oriented protocols can be handled in full duplex depending on the program implemented. The main elements of the module are a Signetics 2652 Multi-Protocol Communications Controller, a Zilog Z-808 8 bit microprocessor with PROM and RAM, and FIFOs for buffering. (FS)

9034 (Y—2190) **Noncontact, laser interferometer sweep gage.** Barkman, W.E. (Oak Ridge Y-12 Plant, TN (USA)). 19 Nov 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

Parts that are manufactured with diamond tools on precision machines typically exhibit high-quality surfaces and contours; however, most materials that are diamond turned easily are also relatively soft and damage easily. Therefore, a noncontact, rotary inspection machine was developed. This machine utilizes a focused beam from a laser interferometer to measure variations in the surfaces of the reflective, spherical test parts used to characterize precision machines. Digital output data from the laser display is converted to an analog signal which is available for additional processing to provide contour and/or surface texture information.

9035 (Y/DX—81) **Use of tangent mounts for diamond machining optics.** Arnold, J.B.; Steger, P.J.; Yoder, R.C. (Oak Ridge Y-12 Plant, TN (USA)). 19 Oct 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

A fundamental requirement for precision diamond machining is the use of a proper part support technique. Various fixturing techniques have been used during diamond machining to minimize or duplicate the strain that the part will be subjected to during use. These techniques include: three-point support, one-point support, potting, collet chucking, and vacuum chucking. During the production of a 15-inch-diameter reflaxicon, its two components, a ring axicon and center axicon, were assembled in tangent mounts and supported using a vacuum chuck. The tangent mount reduced the fixturing strain by increasing the distance the strain must propagate through, and by increasing the rigidity of each component relative to the spindle fixture. Non-flatness error of approximately 40 μin (1 μm) in the support flange of the tangent mount resulted in less than 2 μin (.05 μm) distortion in the optical surface.

9036 **Microprocessor-based controller for nuclear instruments.** Byrd, J.S. (DuPont, Savannah River Lab, Aiken, SC). *IEEE Trans. Nucl. Sci.;* **NS-25**: No. 5, 1106-1110(Oct 1978).

A microprocessor-based digital controller was developed to control the operational modes and the data output of a nuclear PHA (pulse height analyzer). The controller communicates with the PHA via a full duplex serial communications line. Only four wires are required between the devices; therefore, this method is very desirable for remote applications located from the controller. The I/O (input/output) device for the controller is a standard 110-baud keyboard terminal or a 2400-baud interface. A SC/MP-II (permanent software) provides the control functions and output data formatting. The firmware may be easily changed to control other instruments.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

9037 (LA-UR—79-2769) **Sympathetic detonation.** Bowman, A.L.; Richardson, D.E. (Los Alamos Scientific Lab., NM (USA); Hercules, Inc., Magna, UT (USA)). 1979. Contract W-7405-ENG-36. 18p. (CONF-790975—2). Dep. NTIS, PC A02/MF A01.

From CPIA-JANNAF combustion conference; Monterey, CA, USA (10 Sep 1979).

The results of a combined experimental and theoretical study of sympathetic detonation of VRO propellant are summarized. The extent of sympathetic reaction has been determined experimentally for different sizes and shapes of propellant. The experiments have been modeled numerically using the LASL reactive hydrodynamic code 2DE with Forest Fire burn rates. The critical separation distance for high-order detonation has been calculated for the cylindrical equivalents of 1-, 2-, and 3-inch cubes, and is in excellent agreement with experiment. The calculated behavior of the total system is shown with a computer-generated movie, and details of the pressures in the air gap and in the acceptor are presented.

9038 (LA-UR—79-3106) **Primer on SDT, DDT, XDT, pickup, and sympathetic detonation.** Smith, L.C.; Craig, B.G. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 13p. (CONF-790975—4). Dep. NTIS, PC A02/MF A01.

From CPIA-JANNAF combustion conference; Monterey, CA, USA (10 Sep 1979).

The basic principles and causes of accidental explosions are described. (TFD)

9039 (LA-UR—79-3257) **Flowing afterglow spectroscopy: an ultrasensitive probe into solid-phase decomposition kinetics.** Taylor, G.W.; Andrews, G.H. Jr. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 30p. (CONF-7905125—1). Dep. NTIS, PC A03/MF A01.

From 5. symposium on chemical problems connected with the stability of explosives; Bostod, Sweden (May 1979).

The thermal-decomposition kinetics of high explosives are important to manufacturers and these dangerous materials from the standpoint of processing and storage. Low-temperature kinetics (20 to 200°C) are difficult to obtain. Either extremely sensitive analytical techniques must be employed or very large amounts of material must be tested by less sensitive methods. The latter technique has the disadvantage that when sensitive explosives or propellants are so tested, catastrophic reaction can result in the destruction of expensive equipment, and the time involved in testing may be extremely long. The flowing-afterglow method, proposed here, utilizes small explosive samples and an ultra-sensitive analytical approach. The paper describes the technique in detail and summarizes our recent efforts to elucidate the low-temperature kinetics of trinitrotriaminobenzene (TATB) and nitroguanidine (NQ).

9040 (SAND—79-1169C) **Initiation of granular explosives by ramp waves.** Setchell, R.E. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 22p. (CONF-790975—5). Dep. NTIS, PC A02/MF A01.

From CPIA-JANNAF combustion conference; Monterey, CA, USA (10 Sep 1979).

Initiation processes in granular explosives experiencing finite-risetime loading, in contrast to shock loading, have been investigated experimentally. Ramp waves having a risetime of either 0.3 μs or 0.8 μs were transmitted into the explosive PBX-9404, resulting in initial waves having a peak axial stress of 5.1 GPa. The incident waves were generated in discs of a glass-ceramic, pyroceram, by planar impact of copper-faced projectiles using a gas-fired gun facility. Velocity interferometry (VISAR) was used to measure particle velocity histories after the initial wave had propagated through explosive samples having different thicknesses. For comparison, similar measurements were made for the case of shock loading to the same initial peak stress. The slower-rising ramp wave initially loads the explosive at an average rate of 7 GPa/μs. The VISAR measurements show that initiation processes leading to detonation are strongly inhibited at such a rate of compression. After a propagation distance of 4.0 mm this ramp wave has steepened into a shock, but a relatively small rise in particle velocity following the shock suggests that little chemical energy has been released. Thus, velocity profiles measured up to this position provide detailed information on the mechanical characteristics of the unreacted explosive. After propagating 5.0 mm this wave has evolved into a stronger shock, with clear evidence of compressive disturbances being generated behind this wave. Comparisons between this profile and the shock-initiation profiles, however, show that shock loading results in much more rapid growth towards detonation. After propagating 3.0 mm the shock-input measurements show far more evidence of chemical energy release, with full detonation predicted for this case by 5.0 mm.

9041 (UCID—18333) **Performance and properties of extrusion cast explosives composed of HMX, FEFO, and AFNOL.** Hallam, J.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 38p. Dep. NTIS, PC A03/MF A01.

This report contains the results of a comprehensive program to develop a series of Extrusion Cast Explosives (ECX) composed of HMX and AFNOL, an energetic, cast-curable binder that is plasticized with FEFO. An ECX can be extruded into containers of almost any configuration and then cured in place without any shrinkage or loss of homogeneity. Early experiments showed that in the cured state ECXs are extremely insensitive to impact, and their composition can be adjusted to give different energies; a formulation containing 80 wt % HMX has the equivalent energy of PBX 9404. From this notable beginning the studies rapidly expanded into the important areas of mechanical properties, thermal stability, compatibility, and into more detailed studies of sensitivity and performance. Small channels filled with ECX are dependable, high-energy detonation trains.

NUCLEAR

9042 (UCID—18300(Pt.1)) **LLL K Division nuclear test effects and geologic data base: glossary and parameter definitions (U).** Howard, N.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Nov 1979. Contract W-7405-ENG-48. 72p. Dep. NTIS, PC A04/MF A01.

The report lists, defines, and updates Parameters in DBASE, an LLL test effects data bank in which data is stored from experiments performed at NTS and other test sites. Parameters are listed by subject and by number. Part 2 of this report presents the same information for parameters for which some of the data may be classified.

WEAPONRY

9043 (UCID—18494(Pt.1)) **Conflict Simulation Laboratory-II. Part I. Functional requirements.** Ames, H.S.; Bly, S.A.; Hager, R.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Nov 1979. Contract W-7405-ENG-48. 27p. Dep. NTIS, PC A03/MF A01.

The Conflict Simulation Laboratory (CSL) provides graphic and computation tools to model nuclear combat through simulated tactical battlefields and war games. By introducing new weapon effects, new weapon systems, or new organizations, an analyst can war game a variety of doctrines, force deployments, and tactics. Once the basic parameters are determined, the analyst can try various iterations to determine sensitivity to variations of these parameters. The CSL facility has been very useful but needs to be enhanced to handle future studies. This document is the first in a series leading to the development of the hardware and software which will be referred to as the second generation Conflict Simulation Laboratory. The document is divided into three parts: a brief description of the existing capabilities, a description of the functions of the proposed system, and a justification for the proposed system. 3 figures, 2 tables. (RWR)

9044 (UCID—18494(Pt.3)) **Conflict Simulation Laboratory-II. Part 3. Schedules and costs.** Ames, H.S.; Bly, S.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Dec 1979. Contract W-7405-ENG-48. 34p. Dep. NTIS, PC A03/MF A01.

This document contains a strategic plan for the development of the LLL second-generation Conflict Simulation Laboratory, CSL-II. CSL-II provides graphic and computation tools to model nuclear combat through simulated tactical battlefields and war games. By introducing new weapon effects, new weapon systems, or new organizations, an analyst can war game a variety of doctrines, force deployments, and tactics. The project will require the purchase of a high-speed computer and graphics devices and the conversion of

existing simulation codes to run on the new computer. This document contains estimates of the manpower requirements, hardware costs, and development schedules for development of CSL-II. 12 figures, 5 tables. (RWR)

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 8712

9045 (BNL—26840) **Recommended changes in meteorological measurement and prediction methods for coastal sites.** Raynor, G.S.; Michael, P.; SethuRaman, S. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract EY-76-C-02-0016. 5p. (CONF-800107—2). Dep. NTIS, PC A02/MF A01.

From 2. conference on coastal meteorology; Los Angeles, CA, USA (30 Jan 1980).

A study was performed to examine currently recommended meteorological measurement programs and atmospheric transport and diffusion prediction models for nuclear power plants to determine their adequacy for plants located in coastal zones where meteorological conditions are normally more complex than at inland sites and to make recommendations for changes to improve current procedures. Recommendations were based on an extensive literature review and on studies of coastal meteorology and diffusion. The study was focused on the following areas: coastal internal boundary layers; tower location; instrument heights; atmospheric stability classification; plume meander; and diffusion calculations. Each of the areas is discussed with appropriate recommendations which were made with respect to either the scientific or the regulation aspects of current procedures or both. Other potential problem areas are also pointed out.

9046 (BNL—26841) **Climatology of internal gravity waves in the marine surface layer in a coastal environment.** SethuRaman, S.; Nagle, C.; Raynor, G.S. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract EY-76-C-02-0016. 3p. (CONF-800107—3). Dep. NTIS, PC A02/MF A01.

From 2. conference on coastal meteorology; Los Angeles, CA, USA (30 Jan 1980).

The climatological variations of the occurrence of internal gravity wave events at a coastal site as compared with an inland site are discussed, and possible reasons for the differences are given. Stable atmospheric conditions that are conducive for the formation of internal gravity waves occur at all hours at a coastal site. At inland sites, stable conditions occur only during nights due to daytime surface heating by solar radiation. Thermal inertia of large bodies of water, on the other hand, prevents the formation of a diurnal cycle of heating and radiational cooling. During spring and early summer, cooler ocean water causes the formation of stable atmospheric layers near the surface when warmer air masses move in from land. Internal gravity waves tend to get generated and break in these layers and affect the transport and diffusive characteristics of the atmosphere. Meandering of plumes of materials released in the atmosphere during stable conditions is one affect. The internal waves seem to form in air masses with moderate wind speed in the range of 3 to 8 m sec^{-1} and have significant amplitudes. Mean periods of the waves were around 6 to 9 minutes.

9047 (COO—2874-T2) **Statistical considerations in network design.** Switzer, P. (Stanford Univ., CA (USA). Dept. of Statistics). Aug 1979. Contract EY-76-S-02-2874. 14p. Dep. NTIS, PC A04/MF A01.

Following some general remarks on the importance and unimportance of optimization in spatial network design, exploitation of spatial autocorrelations and covariate information is considered. It is pointed out that spatial autocorrelations, themselves, require care in their estimation; and two illustrations are given to show how probabilistic error calculations are made for mapping problems using network station data. One illustration uses a quantitative mapping variable and the other uses a qualitative mapping variable.

9048 Role of computational chemistry in the science and measurements of the atmosphere. Phillips, D.H. (National Aeronautics and Space Administration, Hampton, VA). pp 1-6 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Modern computational chemistry is a powerful tool for the investigation of the highly reactive and short lived species of the atmosphere. Since the computations only deal with the molecular system of interest they are not limited by problems of wall reactions, side reactions, low concentrations or diffusion rates. The role of computational chemistry in determining the stability, photochemistry, spectroscopic parameters, discussed. Examples dealing with the photolysis cross sections of HOCl and ($^1\Delta$/sub g/) O_2 and the stability of gaseous NH_4Cl and asymmetric ClO_3 are presented. The implications of each of these for upper atmosphere chemistry are discussed.

9049 Impact of chlorofluoromethane and NO/sub x/ injections on stratospheric ozone. Stolarski, R.S. (National Aeronautics and Space Administration, Greenbelt, MD). pp 20-26 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Over the past several years numerous evaluations of the potential effect of the injection of chlorofluoromethanes (CFM's) and NO/sub x/ on stratospheric ozone have been made. As laboratory reaction rate and cross section data have accumulated and improved and as stratospheric photochemisty models have become better and more complex, the evaluations of the effect of CFM injection, NO/sub x/ injection by SST's, and NO/sub x/ increases due to increased fertilizer usage have continued to change. The most recent assessment of the CFM effect indicates ozone reductions approximately double those found in the recent National Academy study. The same models applied to NO/sub x/ perturbations indicate a very low sensitivity of column ozone.

9050 Some aspects of the interaction of radiation with the thermal and mass budgets of cloud droplets. Barkstrom, B.R.; Stephenson, D.M. (George Washington Univ., Hampton, VA). pp 147-148 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

In standard treatment of the mass and energy budget of cloud droplets, radiant energy transfer is neglected on the grounds that the temperature difference between the droplet and its surroundings is small. Calculation of the actual rate of energy deposition in the droplets, using only radiation in the 8 to 12 μm window, shows that radiant energy deposition may alter the growth rates of the droplets by an order of magnitude and change the sign of mass deposition. The calculation is based on the Eddington approximation to the transfer equation, and accounts for radiation incident on both the top and bottom of the cloud. The model assumes that the cloud is isothermal and has an altitude independent drop size distribution. The increased growth rates make it easier to understand broad droplet spectra and rain from warm status clouds, since it is easier to grow large droplets. In addition, droplets may be cooler than the surrounding gas, even in a supersaturated environment, which may make diffusio-phoreisis and thermophoreisis work together to increase the scavenging efficiency of droplets. Thus, radiative heating or cooling may control many aspects of cloud-environment interaction.

9051 Particulate pollutants: real-time tracking and monitoring of their cloud nucleation characteristics. Saxena, V.K. (Univ. of Denver, CO). pp 152-155 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Particulate pollutants of a plume are customarily measured n terms of the mass concentration of total suspended particulates (TSP). Such measurements do not afford an opportunity to evaluate the impact of particulate pollutants on the cloud microstructure which, in turn controls the precipitation patterns. During cloud forming processes, only a fraction of TSP participates. This fraction consists of a cloud condensation nuclei (CCN) whose cloud nucleation characteristics are effectively represented by a plot of cumulative number of unstably-growing cloud droplets as a function of supersaturations comparable to those encountered in a natural cloud or fog formation. Such a plot is referred to as the activity spectrum of CCN. Our newly developed CCN Spectrometer provides real-time, in situ, and continuous measurements and display of the entire CCN spectrum within 15 sec. It helps track an air mass by using CCN Spectrum as a natural tracer, to detect in situ formation of CCN resulting from gas-to-particle conversion and coagulation processes, provide necessary data for analyzing the interaction. The usefulness of this instrument is exemplified by discussing airborne measurements downwind of the St. Louis metropolitan area.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 8046, 8445, 8638, 9209, 9210, 9212, 9340, 9377, 9378

9052 **Fourth joint conference on sensing of environmental pollutants.** Washington, DC; American Chemical Society (1978). 963p. (CONF-771113—).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Because of the importance of communication among those involved in the scientific, engineering, governmental and public aspects of environmental problems, the technical methodologies and the definition and evaluation of the consequences of man's interaction with his environment. The objective was to create dialogues among those who set standards, those who perform measurements, and the scientists and engineers who develop measurement and design instruments. The program included an opening plenary session to introduce those attending the Conference to the national and international implications of pollution studies, 245 papers organized into 38 technical sessions, and two concluding panel discussions.

9053 (EML—363, pp II.60-II.122) **Project Airstream: trace gases in the stratosphere.** Leifer, R.; Toonkel, L.; Larsen, R. 1 Oct 1979.

In Environmental Measurements Laboratory environmental quarterly, June 1-September 1, 1979.

As part of continuing studies of radioactive particulates and selected trace gases in the stratosphere, trace gas data taken on the April 1977, July 1977, October 1977, July 1978, and October 1978 missions are reported. Information is included on CCl_3F, SF_6, CCl_4, N_2O, and CCl_2F_2. (JGB)

9054 (EML—367) **Environmental Measurements Laboratory regional baseline station, Chester, New Jersey.** (Department of Energy, New York (USA). Environmental Measurements Lab.). Oct 1979. 253p. Dep. NTIS, PC A12/MF A01.

Various programs underway at the Chester, New Jersey facility are discussed. Eight of the nine sections were abstracted and indexed individually for ERA/EDB. The section not abstracted contains extensive meteorological data obtained at Chester, New Jersey, from July 1978 to July 1979. (JGB)

9055 (EML—367, pp 5-21) **Measurements of the chemical composition of wet, dry and total atmospheric deposition.** Feely, H.W.; Larsen, R. Oct 1979.

In Environmental Measurements Laboratory regional baseline station, Chester, New Jersey.

Samples of atmospheric deposition have been collected at the Chester site since October 1976 using an open, high-walled plastic bucket as a total collector, and using a wet/dry collector to obtain separate samples of rain and of dry deposition. These samples were measured for conductivity and pH at EML, and then 250 ml portions of each were filtered through Millipore 0.45 μ membrane filters and analyzed by a contractor laboratory for pH, conductivity, Na^+, K^+, Ca^{2+}, Mg^{2+}, NH_4^+, SO_4^{2-}, NO_3^-, Cl^-, HCO_3^-, and PO_4^{3-}. Some samples were measured also for Al, Fe, Pb, V, Mn, Ni, Cr, Zn, As, and Cd. The available data on the concentrations measured in the samples of wet deposition, and the calculated deposition, in terms of microequivalents per square meter, for wet, dry and total deposition, respectively, are tabulated.

9056 (EML—367, pp 74-235) **Trace gas concentrations.** Krey, P.W.; Larsen, R.; Toonkel, L. Oct 1979.

In Environmental Measurements Laboratory regional baseline station, Chester, New Jersey.

The trace gases measured in the Chester environment are sulfur dioxide, the oxides of nitrogen, and ozone. These gases relate to power and industrial production, and have an impact upon air quality. The first measurements of O_3 at Chester, the concentrations of the oxides of nitrogen through December 1978, and of SO_2 through July 1979 are reported.

9057 (EML—367, pp 248-250) **Atmospheric carbon dioxide monitoring at the Chester site.** White, C.G.; Lagomarsino, R.J. Oct 1979.

In Environmental Measurements Laboratory regional baseline station, Chester, New Jersey.

Several atmospheric carbon dioxide concentration monitoring operations have been conducted at the Chester site in an effort to prove the viability of a monitoring apparatus constructed at the Environmental Measurements Laboratory (EML) in New York City. It was the aim of the Laboratory to assemble a system capable of measuring atmospheric carbon dioxide concentrations with the same accuracy and precision that has been established as a requisite by the Scripps Institution of Oceanography (SIO). Accordingly, a gas manipulation manifold was built and interfaced with an Esterline Angus model 743 Non-Dispersive Infrared Analyzer, which was calibrated using standards purchased from Scripps. Data pertaining to carbon dioxide concentrations at the Chester site are tabulated. Intercomparisons with other laboratories indicate that EML is in satisfactory agreement with the more experienced laboratories. Details of the interlaboratory studies will be published elsewhere.

9058 (EPA/600/9—78-022) **Energy environment III.** (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). Oct 1978. 386p. (CONF-7806137—). Environmental Protection Agency, Office of Research and Development, Washington, DC.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

R and D Decision Series.

Energy/Environment III provides an update of Interagency research in particular areas, including health effects, transport processes and ecological effects, mining methods and reclamation, control technology, and integrated technology assessment. This report consists of the addresses, papers, and panel discussions of the Conference. Fifteen papers were abstracted and indexed individually for EDB/ERA. Six of them are also included in EPA.

9059 (EPA/600/9—78-022, pp 95-112) **Monitoring of air and water quality in the Western region.** McNelis, D.N. (Environmental Protection Agency, Las Vegas, NV); Pueschel, R.F. Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

Concerns associated with water quality and supply and air quality in the Western Energy Source Development Area (WERDA) are discussed. The status and initial results of an interagency program directed at integrating air and water quality research and monitoring data are described. States in WERDA are Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah, and Wyoming. (JGB)

9060 (EPA/600/9—78-022, pp 113-119) **Ecological effects of atmospheric deposition.** Glass, N.R. (Environmental Protection Lab., Corvallis, OR); Likens, G.E.; Dochinger, L.S. Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

Anticipated long-range effects of wet and dry deposition of atmospheric pollutants are discussed. Impacts of acid precipitation on aquatic and terrestrial ecosystems, as well as man-made materials, are reviewed. (JGB)

9061 (EPA/600/9—78-022, pp 121-149) **Ecological effects of coal-fired steam-electric generating stations.** Glass, G.E. (Environmental Protection Agency, Duluth, MN). Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

Studies on the environmental effects of the Columbia Coal-Fired Generating Sation near Portage, Wisconsin before, during, and after construction are reviewed. Emphasis is placed on results of studies on the flow of pollutants, including thermal pollution, through the facility. Details are given on SO_2 and fly ash monitoring. Applications of the mass balance approach for following materials through a complex system are discussed. (JGB)

9062 (EPA/600/9—78-022, pp 165-185) **Methods for the control of environmental damage caused by mining energy producing materials.** Hill, R.D.; Harris, E.F.; Hubbard, S.J. (Environmental Protection Agency, Cincinnati, OH). Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

Various environmental problems connected with the mining of coal, oil shale, and uranium, including acid mine drainage, are discussed. Waste disposal and land reclamation methods are reviewed. Research projects underway to address these problems are outlined. (JGB)

9063 (EPA/600/9—78-022, pp 253-273) **Flue gas desulfurization of combustion exhaust gases.** Kaplan, N.; Maxwell, M.A. (Environmental Protection Agency, Research Triangle Park, NC). Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

There are currently six types of flue gas desulfurization (FGD) processes in use for control of $S0_2$ emissions from full scale utility systems. They are limestone slurry scrubbing, lime slurry scrubbing, lime/alkaline fly ash scrubbing, soda ash solution scrubbing, magnesium oxide scrubbing, and Wellman-Lord/Allied Chemical processes. Each system is described. Some of the more significant current federal FGD programs are summarized. Reported costs of operating utility FGD systems are tabulated. (JGB)

9064 (EPA/600/9—78-022, pp 275-289) **Disposal of power plant wastes.** Jones, J.W. (Environmental Protection Agency, Research Triangle Park, NC). Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

A major effort in the Energy/Environment Program is underway to characterize solid wastes from power plants and to develop technology to minimize the potential adverse environmental impacts of these wastes. The program has achieved significant results in a number of areas, which are discussed. Flue gas cleaning (FGC)

wastes have been characterized physically and chemically; a variety of disposal options have been identified, including detailed costs associated with these options. Disposal of these wastes in coal mines is economically attractive and, therefore, is being investigated through lab and field tests. Methods for achieving major cost reductions in FGC waste disposal have also been identified and are making their way into the process supply market; these include oxidation to gypsum and improved dewatering equipment. Results of these efforts are providing a technical data base for the regulation of the disposal of power plant wastes.

9065 (IVL-B—444) **Atmospheric formation, dispersion, and deposition of acid substances.** Brosset, C. (Swedish Water and Air Pollution Research Lab., Goeteborg). Jun 1978. 15p. (CONF-7805191—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Spring meeting of the Swedish Association for Water Hygiene; Gothenburg, Sweden (9 May 1978).

The primarily emitted gases SO_2 and NO may oxidise in the atmosphere, and in the case of SO_2, also after dry deposition in the recipient. Oxidation in the atmosphere may take place either photochemically or catalytically. The acid substances formed in such a process may directly or indirectly be introduced into the recipient in the form of the strong acids H_2SO_4 and HNO_3 as well as the weak acids HSO_4^- and NH_4^+, of which the latter results from the participation of NH_3 in the atmospheric processes. The potential acidifying effect of a deposition is associated with the concentration sum c/sub $H/^+$ + c/sub $HSO_4/^-$ + c/sub $NH_4/^+$ where the partial sum c/sub $H/^+$ + c/sub $HSO_4/^-$ corresponds to the immediate effect. Two forms of deposition are assumed to be responsible for the main part of acidification: dry deposition of SO_2 (and, most likely, HNO_3) and wet deposition of c/sub $H/^+$ + c/sub $HSO_4/$. These depositions are caused by local emissions as well as by long distance transport from remote sources. The latter form is probably the one of greatest importance in Scandinavia.

9066 (LA—8119-MS) **Fibrous aerosol studies.** Ortiz, L.W.; Tillery, M.I.; Ettinger, H.J.; Martinez, J.I. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 45p. Dep. NTIS, PC A03/MF A01.

The research effort conducted over several years on glass and asbestos fibers for the National Institute for Occupational Safety and Health, Department of Health, Education, and Welfare is summarized. Contents of this report are subdivided into two major categories: fibrous glass studies and asbestos studies. Both major topics contain subtopics including aerosol generation, aerodynamic size characterization, and sampler evaluation. The section on asbestos studies also contains related subtopics on microscopy and asbestos.

9067 (TAC-RS—79-002) **Remote sensing of natural resources. Quarterly literature review, April-June 1979.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Sep 1979. 392p. Technology Application Center, Albuquerque, NM.

The literature of remote sensing was reviewed and a selection made of documented data and data gathering techniques that are performed or obtained remotely from space, aircraft, or ground-based stations. All of the documentation is related to remote sensors or the remote sensing of the natural resources. Meteorology and extraterrestrial sensing were usually not selected. Sensors are primarily those operating with the 10^{-6} to 1 meter wavelength band. The nine areas covered are: general; geology; environmental quality; hydrology; vegetation; oceanography; regional planning and land use; data manipulation; and instrumentation and technology. An author index is included. (JGB)

9068 **Airborne fluorides and man. Part II.** Smith, F.A. (Univ. of Rochester, NY); Hodge, H.C. *CRC Crit. Rev. Environ. Control;* **9**: 1-25(Feb 1979).

It has long been recognized that some species of vegetation, as well as some animals, e.g., dairy cattle, are especially sensitive to fluoride. As a result, standards governing the emission of fluorides from industrial sources, fluoride concentrations in the ambient air downwind from such sources, and fluoride concentrations in vegetation have been established. These standards, as well as occupational standards in various nations, are reviewed.

9069 **Airborne fluorides and man. Part I.** Smith, F.A. (Univ. of Rochester, NY); Hodge, H.C. *CRC Crit. Rev. Environ. Control;* **88**: 293-371(Jan 1979).

In this review the presence of fluoride in the environment as it originated from natural sources and from man's activities was discussed. Considerable attention was devoted to atmospheric concentrations encountered in the work place and to the incidence, nature, and magnitude of the responses seen in workers encountering airborne fluorides during long-term employment. It was concluded that the current Occupational Safety and Health Administration (OSHA) standards for occupational exposure to inorganic fluorides and to hydrogen fluoride will not injure human health during a working lifetime. Investigations into the health of populations living in the vicinity of fluoride-emitting industries were reviewed, and it was concluded that these emissions have little, if any, significant effect upon the health of nearby residents.

9070 **Effect of anthropogenic carbon monoxide on the methane budget of the troposphere.** Chameides, W.L. (Univ. of Florida, Gainesville). pp 7-13 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The anthropogenic emission rate of CO is believed to be comparable to natural sources and thus, if present trends continue, the global CO abundance may increase in the coming decades. However, our present understanding of the tropospheric photochemical system implies that an increase in the CO density will likely result in a perturbation in the abundance of the free radical OH, which will in turn cause variations in atmospheric CH_4 and other compounds. These variations could have significant implications for the stability of stratospheric O_3 and the atmosphere's thermal equilibrium. In this paper, photochemical model calculations are presented to assess the effects of future CO emissions upon the atmosphere. The calculations include simulations in which nitrogen oxide emission rates are increased simultaneously with CO emission rates to determine their combined effect upon the CH_4-OH system.

9071 **Tropospheric ozone.** Stewart, R.W. (National Aeronautics and Space Administration, New York, NY); Hameed, S.; Pinto, J. pp 14-19 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Photochemical equilibrium models were used to study the effect of recent revisions in important chemical reaction rates on the calculated tropospheric ozone concentration. Reasonable agreement with observed values is obtained if the NO/sub x/ background is ≃ 0.02 to 0.03 ppB, about an order of magnitude less than used in many previous model studies, but consistent with present nitrogen budget considerations and with observations of NO_2. Chemical production and loss of ozone may dominate transport terms depending on values of key chemical rate constants and of the NO/sub x/ background. This is consistent with the structure observed in the mean annual latitudinal distribution of ozone, since ozone is its own chemical precursor and regions of enhanced stratosphere-troposphere exchange are also regions of enhanced photochemical activity.

9072 **North-south concentration gradient of aerosol sulfur in Florida.** Winchester, J.W.; Leslie, A.C.D.; Ahlberg, M.S. (Florida State Univ., Tallahassee). pp 27-29 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Mean sulfur concentrations in six particle size fractions, from <0.25 to $>4\mu m$ aerodynamic diameter, have been determined in Florida during July-August and December 1976 sampling seasons. A trend of decreasing concentration along the length of Florida, at ten sites from Pensacola to Miami, is found for sulfur in the fine particle mode, $<2\mu m$ diameter, but not for $>2\mu m$ coarse mode sulfur. The trend is most regular for 0.5 to 1 μm particles, and urban concentrations show no consistent departure from the nonurban trend in this size range. Smaller and larger particle concentrations are more locally variable. The trends are interpreted in terms of a flow of continental air, containing a pollution-derived fine particle sulfur component, into Florida during northerly wind regimes and of less polluted maritime air with southerly flow. The magnitude of the apparent decrease in average concentration from north to south is dependent on the mix of air flow regimes at various locations in the state during the sample collection periods. The qualitative finding of the decreasing trend, however, may be typical in Florida over much of the year and may be useful for designing epidemiological studies of the relation between fine particle sulfur and public health.

9073 **Remote sensing of SO_2, a data processing methodology.** Millan, M.M. (Environment Canada, Downsview, Ontario). pp 30-33 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A methodology was developed to process the data obtained with a ground based COSPEC to determine plume diffusion parameters. This mobile instrument views the plume from underneath and measures the vertically integrated SO_2 concentration profile as it travels along available roads. If the roads are not straight, the SO_2 profiles have a road dependence as well as the angular dependence between the plane of cut and the average plume. A set of criteria has been determined to establish when the measured profiles are representatives of the plume concentrations and, if they are, to determine a projecting plane. Two types of averages can be made with respect to the projected profiles, an Eulerian or space average which yields

information on the absolute diffusion, and a pseudo-Langrangian, or center of gravity, average which gives an insight on the relative diffusion, turbulent and/or wind shear dominated. Various examples will be presented and the results discussed in the context of the available Gaussian plume diffusion models.

9074 Emission sampling method for solid particulates, sulfuric acid mist, and sulfur oxides. Mercer, C.J. (Arizona Dept. of Health Services, Phoenix). pp 34-39 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Some copper smelter emissions contain mineral solids, metallurgical fume, and large amounts of sulfuric acid mist. It was only found by testing that the standard test method for particulates was not satisfactory for sampling some of the smelter emissions. The problem was that sulfuric acid mist partly collected on the filter by condensation or adsorption and partly passed through the filter. A cooperative program was initiated by the state agency with the copper smelting industry to develop an improved sampling method. Sampling methods tried experimentally were: total freeze-out sampling using liquid nitrogen temperature; partial freeze-out using dry ice acetone temperature; instack filtration and impinger collection; elevated temperature out of stack filtration and impinger collection; elevated temperature viscous liquid impinger collection with low temperature impinger collection; and elevated temperature out of stack filtration, low temperature impinger collection and special solvent extraction procedure. The most satisfactory method was the last, which was tried on four of seven operating smelters with satisfactory results. The test method may be applicable to other industrial emissions containing both solid particulates and sulfur oxides.

9075 Recent advances in correlation spectroscopy for the remote sensing of SO_2. Millan, M.M. (Environment Canada, Downsview, Ontario). pp 40-43 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The COSPEC remote sensor is a spectroscopic system which utilizes the ultraviolet absorption bands of SO_2 and the sky radiation at those wavelengths to measure SO_2 plumes in the atmosphere. As a passive sensor, changes in backgrounds such as those due to sky-cloud variations, solar elevation, etc., affect the performance of the instrument, signal to noise ratios, and baseline stability. A setup procedure has been devised which minimizes the effects of background changes, and results in a virtually drift-free baseline. This procedure and the theoretical basis for its development will be presented. An example of its practical results has been the detection of a tall stack plume at 400 km from its source.

9076 Impact of a coal fired power plant on ambient sulfur dioxide levels. Goodell, B.D.; Ragland, K.W. (Wisconsin Univ., Madison). pp 44-48 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Sulfur dioxide concentrations near a new 540 MW coal-fired power station which burns Montana coal with 0.8% sulfur were investigated. SO_2 was monitored continuously for two years preceding start up in July 1975 and continuously thereafter. The Columbia Power Station is located 25 miles north of Madison, Wisconsin, which is the only other significant source of SO_2 within 75 miles of the site. The monitoring data from seven sites is presented in order to show the impact of the power plant on ambient levels of SO_2. The monitoring data was used to validate a Gaussian Plume Model for the year 1976. During this period hourly meteorological data and power plant load data were recorded. Emission rates, and stack gas flow were correlated to load from stack test data. The validation study was based on 5929 hours of complete data. A detailed comparison of the model with monitoring data is made on an annual average basis, by stability categories, and on an hour-by-hour basis. The annual average correlation coefficient for seven sites was 0.95, while the hour-by-hour correlation coefficient fo the year was 0.36.

9077 Simulating the environmental impact of coal-fired electric power generation. Gaud, W.S. (Northern Arizona Univ., Flagstaff). pp 57-60 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The probable environmental impacts of the Navajo Generating Station under construction and the proposed Kaiparowits Generating Station were investigated. Both would burn coal for electric power, and the latter station would be the largest in the world. The objectives were to determine whether the operation of either, or both, of the power plants would have a significant ecological impact on the surrounding ecosystems. It was obvious that traditional methods of ecological mensuration, such as transect sampling for frequency, density, etc., would be inappropriate in these desert ecosystems where variability in natual patterns was so large that small disturbances from human activities would be masked by large natural changes. Therefore, a mathematical model of one of these desert ecosystems was constructed to simulate the natural system and the addition of pollutants from coal combustion. The modeling technique allows one to: identify the environmental variables on which the relevant ecological responses depend; test the validity of the model by field studies and observation; predict impact in the future by simulation now; and, indicate whether preventative measures appear necessary and to what extent they should be applied.

9078 Terrestrial insects sense air pollutants. Bromenshenk, J.J.; Gordon, C.C. (Montana Univ., Missoula). pp 66-70 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Some terrestrial insects display considerable potential as early warning systems and as continuous monitors of the biological effects of environmental pollutants. The results of our studies concerning insect-pollution interactions and those of other investigators indicate that key species of insects are sensitive or vulnerable to pollution-caused or pollution-related perturbations. Insect systems provide components and processes which respond to pollution stress and which are practical to measure and to monitor. Insect indicators are reliable predictors of bionomic and economic consequences of environmental degradation. Honeybees and several species of ground-dwelling beetles were found to be particularly useful for assessing the air pollution impacts of coal-fired power plants on rangelands and associated croplands.

9079 Toward a national system of environmental indicators. Coate, L.E. (Environmental Protection Agency, Seattle, WA); Mason, A.K. pp 77-82 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Better ways of describing the ambient status of the environment have been of increasing concern to all levels of government. Two principal problems have plagued the adoption of a uniform national system of indicators. First, there appears to be insufficient data to rigorously measure the ambient quality of the environment with both precision and consistency throughout the Nation. Second, it has not been possible to each agreement on which of the many technical algorithms is most appropriate for producing indices for water quality, air quality, and for other environmental concerns. In part, the problem can be attributed to a preoccupation with a level of rigor and preciseness that is not needed for either public information purposes or for the bulk of the program evaluation efforts that must be faced. The project described was based on the state-of-the-environment at the regional, state and local level, that was not being used and could be used, if this knowledge was carefully aggregated in appropriate graphical displays. The results of a one-year investigation of this hypothesis in the areas of water quality, air quality, noise, solid waste, pesticides and radiation are presented.

9080 Evaluation of the overall impact resulting from the control of air pollution at stationary sources. Charrington, P.R. (Betz Environmental Engineers, Inc., Plymouth Meeting, PA). pp 83-90 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The total environmental impat of controlling an air pollution problem at its source is evaluated. A brief history of the current state of the art of control evaluations along with a proposed expansion of that methodology is presented. Actual control situation case histories are evaluated from the total environmental standpoint to illustrate the reasons why more emphasis should be placed on the final impact on the environmental of individual air pollution control devices. Examples are given in which source control has a negative impact on the environment.

9081 National program for land use and land cover mapping using remotely sensed data. Kleckner, R.L. (Geological Survey, Reston, VA). pp 91-94 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Because land use and/or land cover are visible indicators of how man interacts with his environment, such data provide valuable information concerning sources of environmental pollution. Using remotely sensed data, the mapping of land use and land cover for the

entire Nation was undertaken. This mapping effort was begun in 1975 and is scheduled for completion by 1982 with updates provided as needed. The land use and land cover categories are those established by the Geological Survey in A Land Use and Land Cover Classification System For Use With Remote Sensor Data, Professional Paper 964.

9082 Development and assessment of a sulfur dioxide contol strategy for a metropolitan area and its surroundings. Skipka, K.J. (Equitable Environmental Health, Inc., Woodbury, NY); Dixon, D.W. pp 94A-94D of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Violations of the ambient air quality standard for sulfur dioxide at a monitoring site in downtown Portland, Maine, and the subsequent use of the rollback technique in the 1973 State Implementation Plan led to a 1.5% fuel sulfur content requirement for all sources in the Metropolitan Portland Air Quality Control Region (AQCR). The 1973 Arab oil embargo and subsequent shortages of low sulfur oil in the Northeast, however, delayed implementing any requirement and prompted a critical review of fuel sulfur requirements in and around Portland, Maine. Both measured ambient air quality data and a computer simulation model were utilized in the review. In validating the US EPA's Climatological Dispersion Model (CDM) for use in the Portland case, a correlation coefficient of 0.9 was obtained between predicted and measured annual concentrations. The high correlation was attributed to an updated emission inventory, especially in the vicinity of the monitoring sites, and to the predictive accuracy of the modified CDM model. Several control strategies were developed and tested via te CDM for effectiveness in attaining and maintaining air quality standards. These strategies were then compared on the basis of economic impact. A review of the available alternative control strategies by the Maine Board of Environmental Protection resulted in the promulgation of a substantially relaxed low Sulfur Fuel Regulation and the delineation of an air quality control subregion. Since the strategy has been employed, all state and federal sulfur dioxide standards have been maintained. The adopted regulation draws a distinction between the urban Portland peninsula area and the remainder of the AQCR. Reducing emissions only in the urban area is perhaps one of the first examples of delineating controls within an AQCR. The subsequent demonstration of attainment of standards throughout the AQCR supports the use of selectively applied regulations.

9083 Ambient air monitoing design: methodology and illustrative examples. McElroy, J.L. (Environmental Protection Agency, Las Vegas, NV). pp 95-100 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A methodology is presented for specifying an ambient air monitoring program based on specific monitoring objectives. The methodology involves both long-term monitoring to document violations of air quality standards and short-term intensive monitoring to provide model parameters and a data base for air quality simulation models used for developing pollution abatement strategies. The methodology also involves the assessment of historical aerometric data to delineate weather regimes for which standards are likely to be exceeded. Long-term monitoing is determined on the basis of preliminary model exercises for these regimes. Intensive monitoing is based on the results of the regime analysis, modeling runs, and local demographic and topographic information. The methodology is applied to two power plants on the Hawaiian Islands, both of which experience complex meteorological and topographical situations.

9084 Queuing of vehicles as a critical contributor of carbon monoxide from mobile sources. Juhasz, P.C.; Rossano, A.T. pp 101-104 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Present evaluations of carbon monoxide emissions from mobile sources are based on evaluation of traffic movements in street segments as line sources, or in indirect sources as area sources. Recent studies indicated that the queuing of vehicles constitutes a major contributor to the air quality deterioration in an area. These studies investigated the emissions in the Cental Business District and the Evergeen Point Toll Bridge at Bellevue, Washington, The results showed that queuing contributes more carbon monoxide than either the line or the indirect sources in the study area. Visual observations, field measurements, and time lapse photography were used to evaluate various phases of vehicular movements at intersections controlled by traffic signal and at tollgates where traffic is restricted by toll pass. Parametric emission data were developed evaluating the correlation between carbon monoxide emissions from mobile sources and various traffic parameters, including the effects of queuing, for several types of inner city street segments. Similar relationship was developed for emissions from queuing vehicles at pay toll gates. Carbon monoxide concentration predictions using the Queuing Model were compared with conventional line source evaluation method. The results indicated that the Queuing Method is a more sensitive indicator of CO concentrations. Emission analyses of these types represent valuable planning tools for predicting pollutant emissions for purposes of air resource management and urban planning to deal with future peak traffic and adverse meteorologic conditions.

9085 Texas Air Control Board's program for quality assurance of hi-volume sampler networks. Richardson, R.L.; Ehman, D.; Jones, D. (Texas Air Control Board, Austin). pp 105-107 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The Texas Air Control Board maintains an ambient air monitoring network of over 100 high volume samplers, extending from El Paso in far West Texas to Orange on the Louisiana border, 900 miles away. Its quality assurance staff has the responsibility of not only quality assuring the Air Control Board's high volume network but also those of six metropolitan air pollution agencies in Texas, including Houston and Dallas. So that data from these samplers are accurate and comparable, the quality assurance staff has attempted to develop a program which produces the maximum amount of useful information within the constraints of available manpower. The three major elements of the program are: standardized operations: including a master quality assurance plan (Task List), a procedures manual, centralized control of operations, training and certification, and finally administrative audits of key operations; field audits of all networks; and a co-location program (interagency sampling at selected sites) which flags systematic and indeterminate errors for both the local and Texas Air Control Board networks. Over the last two years the TACB has quality assured a great number of samplers deployed over an extended area by focusing its energies on those points or activities yielding the most information and/or control for effort expended. Interagency quality control was attained through the Quality Assurance Task List. Intra-agency data quality is monitored through internal auditing by each agency. And finally, the level of intra-agency data comparability was analyzed and improved by a long-term and continuous program of co-location sampling.

9086 Effect of interfering compounds in the fluorescence detection of SO_2. Graham, L.D. (Beckman Instruments, Inc., Fullerton, CA). pp 112-116 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The fluorescence method of SO_2 detection, though rapid and sensitive for measuring very low levels of SO_2, suffers drastically from interfering compounds present in ambient. Some investigations in characterizing these interfering compounds and techniques developed to minimize these interferences and make the method a viable analytical technique are discussed. The magnitude of interference from CO, CO_2, NO/sub x/, common organic solvents and many hydrocarbon - single and complex aromatics, and polynuclear aromatics - was investigated. Though a typical interfering compound could not be isolated in the ambient air, the thrust of the investigations yielded data suggesting the prime role of the polynuclear aromatics even if present only at very low trace levels.

9087 Close look at the interactions between dilute solutions of mercury and borosilicate glass surfaces, especially as they relate to the stability of dilute mercury standard solutions. Carden, J.L. (Bogazici Univ., Istanbul, Turkey). pp 117-120 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Three dilute mercury solutions were studied to obtain information about the mechanism of mercury loss. The total mercury and mercury(0) concentrations were measured over a 10 day period. The effect of increasing the surface area of borosilicate glass in contact with the solution was also observed. Mercury reduction followed by volatilization was the primary loss mechanism. The results obtained were in contradiction to simple thermodynamic calculation on these systems indicating that this simple treatment was inadequate. It is proposed that a careful study of the thermodynamics of these solutions would be fruitful.

9088 Limits of acceptability of multipoint calibrations. Casada, S.S. (Northrop Services, Inc., Research Triangle Park, NC); Wagstaff, R.L.; Rhodes, C. pp 121-124 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A statistical study on routine multipoint calibration data was perfomed to establish generalized values to serve as acceptability criteria for future calibrations. The study involved data from the 25 stations of the Regional Air Monitoring System (RAMS) of the St. Louis Regional Air Pollution Study (RAPS) and included measurements of the following pollutants: total hydrocarbons, carbon monoxide, and methane, measured by instrument Type 1; total sulfur and sulfur dioxide, measured by instrument Type 2; and total sulfur, measured by instrument Type 3. Multipoint calibrations on these instruments were performed at each station approximately every 8 weeks to check for linearity and stability of response. Zero and span drift checks were made daily to provide two points necessary for computing a linear transfer curve. The statistical study established the inherent variability of the measuring instruments and the calibration process. Based upon this variability, the following limits were determined. Limits of acceptability of the multipoint calibration, and minimum limits for daily zero and span drift. The use of these types of quality control acceptability limits should improve multipoint calibration and the daily zero and span check operations, and thereby improve the quality of monitoring data.

9089 Simultaneous inference of stratospheric trace gases with overlapping spectral signatures using limb sounding radiometry. Russell, J.M. III (National Aeronautics and Space Administration, Hampton, VA); Gordley, L.L.; Tallamraju, R.K. pp 125-128 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

An inversion algorithm was developed to simultaneously infer the concentrations of two gases with overlapping spectral signatures using limg emission measurements. The algorithm is efficient and provides a solution in two or three iterations. It was applied in a simulation study to the inference of stratospheric NO_2-H_20 and HNO_3-CF_2Cl_2. Existing satellite instrumentation was the basis for errors used in the calculations. It is estimated that concentrations of all four gases can be determined with errors of about 20 percent. This assumes an estimated 1980 CF_2Cl_2 level. Also, other error sources due to contaminant gas, aerosol emission, and the temperature profile must be included to obtain a better estimate of experimental accuracies.

9090 Pressure sensing of the atmosphere by solar occultation: an application to remote sensing of atmospheric minor gases. Park, J.H. (College of William and Mary, Williamsburg, VA); Russell, J.M. III; Drayson, S.R. pp 129-133 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The simultaneous inference of pressure and gas concentration in a remote sensing experiment will increase the accuracy of inverted gas concentrations and minimize the dependence of the experiment on pressure or mass path error resulting from use of climatological pressure data, satellite ephemeris, and instrument pointing accuracy. A technique for obtaining tangent point pressure information needed for inversion of gas concentration in an ir solar occultation experiment is described. By measuring ir absorption in bands of atmospheric CO_2 (e.g., 2.0, 2.7, or 4.3 μ) pressure values for each layer (2 km or less in the vertical) of the atmosphere can be obtained with RMS errors of less than 3%.

9091 Estimation of the vertical ozone distribution from satellite measurements. Thomas, R.W.L. (EG and G Washington Analytical Services Center, Inc., Riverdale, MD); Holland, A.C. pp 135-137 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A simple relationship was established between the vertical ozone profile above the ozone maximum and satellite measured radiances for wavelengths shorter than 3000 A^0. The method is based on the computation of the penetration depths for solar radiation entering the atmosphere at wavelengths employed by the BUV satellite. Suitably defined penetration depths are shown to be linear functions of the normalized intensities for typical conditions, eliminating the requirement for iterative solutions and considerably simplifying the error analysis for the system. For ozone distributions which depart significantly from the exponential form, a noniterative extension of the analysis procedure has been developed and tested through application to simulate intensities.

9092 Comparison of ozone concentrations obtained from SKYLAB eclipse and ozonesonde measurements. McDougal, D.S.; Keating, G.M.; Lee, R.B. III. (National Aeronautics and Space Administration, Hampton, VA). pp 138-142 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A stratospheric ozone profile, determined with a new data reduction scheme, was obtained using the satellite eclipse technique and is compared with simultaneous ozonesonde measurements. The eclipse technique consists of photometrically observing a satellite as it approaches the earth's shadow. The decrease of the apparent satellite intensity due to absorption is measured simultaneously in two narrow bands centered at regions of strong (6022A) and weak (8000A) ozone absorption. A new data reduction scheme, which utilizes a non-linear multiple regression analysis with filtering, is used which properly accounts for the finite size of the sun and is independent of the choice of an initial ozone profile. The NASA Satellite Photometric Observatory (SPO) was used to observe the SKYLAB satellite on August 11, 1976, from Tullahoma, TN. The SPO consists of a mobile 61 cm telescope, a four axis mount, and a four channel photometer. The SKYLAB data yield an ozone profile from 15 to 40 km with a peak concentration of 5.0×10^{12} molecules cm-3 near 25-km. The profile is compared with simultaneous ozone measurements obtained from an ozonesonde lauched from Spokane, WA near the profile tangent point. The comparison shows good agreement with differences of less than 14 percent over the altitude range 20 to 40 km, which is within the eclipse and ozonesonde error estimates.

9093 Use of AVHRR measurements of reflected sunlight for global sensing of aerosol particle optical thickness fom TIROS-N satellites. Stowe, L.L. (National Oceanic and Atmospheric Administration, Washington, DC). pp 143-146 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

In recent years, several investigators have used satellite measurements of reflected solar radiation to infer the optical thickness of atmospheric aerosol particles. Results have shown that a linear relationship exists between the radiance of reflected sunlight measured over water surfaces (MSS on LANDSAT I and II and VHRR on NOAA 3) and aerosol particle optical thickness measured by ground based sun-photometers. The National Environmental Satellite Service (NESS) is planning a similar investigation using AVHRR (Advanced Very High Resolution Radiometer) measurements of reflected sunlight from the TIROS-N series of satellites. The derived regression equations would be applied to measure aerosol particle optical thickness over the oceans. Combined with the land based, world-wide network of sunphotometer turbidity stations, the aerosol particle optical thickness of most of the earth's atmosphere would be measured on a regular basis. This information is important for accurate climate modeling, pollution transpot monitoring, and satellite radiometric analyses. Results from previous satellite investigations are reviewed, and plans for the TIROS-N study are presented.

9094 Co-existence of natural and man-made aerosols in a rural environment. Allee, P.A. (Atmospheric Physics and Chemistry Lab., Boulder, CO); Pueschel, R.F.; Wagner, W.W. pp 149-151 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Aerosol size frequency distributions measured by aircraft in east-central Utah are typically bimodal with modes at particle diameters of 0.05 μm and 0.5 μm. Additional characterization of the aerosol according to particle shape and elemental composition shows that particles of size less than 0.5 μm are predominantly spherical and contain sulfur, whereas particles of size larger than 0.5 μm are mostly irregular and have a mineral-type composition. The findings are independent of the season, but appear associated with persisting stagnant atmospheric conditions. It is concluded that a locally man-made sulfur aerosol is superimposed upon a natural back-ground aerosol. It is proposed that the relative proportions of the man-made component of the aerosol be used as an air quality standard by which future effects of anthropogenic activities on the environment can be evaluated.

9095 Nucleation properties of plume aerosol from a copper smelter. Parungo, F.; Pueschel, R. (National Oceanic and Atmospheric Administration, Boulder, CO). pp 156-158 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

To study the meteorological impact of the pollutants released by the Kennecott Copper Smelter, Salt Lake City, Utah, airborne aerosol samples were collected on Nuclepore filters in the plume at different distances from the stacks. Electron microscopes were used to analyze the morphology, concentration, and size distribution of the aerosol. An x-ray energy spectrometer was used to determine the

elemental composition of the individual particles. The chemical and physical properties were related to cloud condensation and ice nucleation activities which were measured with thermal diffusion chambers. It was found that all the particles contained sulfur and were enveloped in a sulfuric acid liquid layer. The diameters (d) of 95% of the particles were smaller than ine micrometer (μ). The larger particles ($d > 0.5\ \mu$) consisted of Si, Fe, Cu, Ca and/or Mg. The smaller particles ($d < 0.5\ \mu m$) consisted of Pb, As, Se, Sn, etc. Because of their hygroscopic acidic surface, the aerosols are active cloud condensation nuclei. The ice nucleation activity of the aerosol was found to increase with distance downwind. In conjunction with long atmospheric residence times due to the small size of the particles, long range transport and effects on mesoscale cloud structures are possible.

9096 Powder from western coal: fly ash as a reagent for SO_2 scrubbing. Zeliger, H.I. pp 159-161 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The lignites and subbituminous coals of the western United States are generally low in sulfur content, yet many could not meet the federal SO_2 emission standards for electrical power plant generators without some SO_2 removal. Flue Gas Desulfurization (FGD) can be accomplished by utilizing several processes, such as lime/limestone wet scrubbing, dry lime or limestone injection and magnesium or potassium oxide scrubbing, etc. These processes, however, require continuous supplies of large quantities of alkali that may often have to be delivered to remote sites. A relatively new FGD procedure entails the use of fly ash as the source of alkalinity. Fly ash (collected from electrostatic precipitators) obtained from western coal is often high in alkalinity, consisting of 25% or more of calcium oxide. Such fly ash, when properly extracted, may be used alone or with small quantities of supplemental lime to remove SO_2 from flue gas. The increased use of fly ash as a desulfurization reagent should expand the use of western coal for electrical power generation.

9097 Depletion of ambient ozone by a rural coal-fired power plant near Portage, Wisconsin. Bowen, B.M.; Stearns, C.R. (Univ. of Wisconsin, Madison). pp 184-186 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The depletion of ambient ozone by NO in the plume from a rural coal-fired power plant was studied near Portage, Wisconsin in the summer of 1976. O_3, SO_2, NO, and NO_2 were monitored continuously at a ground level site 10 km north of the plant. The O_3 levels were sharply reduced when the plume was present at the site. The plume's presence was indicated by high levels of NO/sub x/ ($NO + NO_2$) and SO_2 associated with a southerly wind. For at least a one hour time period the O_3 concentration met the federal standard of 80 ppB due to the presence of the plume. The analyses indicate that the amount of O_3 depletion is dependent on the ambient O_3 levels and the levels of SO_2 and NO/sub x/ associated with the plume. NO_2 levels from the plume were found to be proportional to the amount of O_3 removed from the ambient air.

9098 Comparison of five published methods for the determination of mercury-in-air. Makris, W.E.; Crawford, C.J.; Miller, R.O.; Bell, Z.G. Jr. (PPG Industries, Inc., New Martinsville, WV). pp 192-195 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Five mercury methods often employed in measuring airborne concentrations in the working environment were compared simultaneously under actual and artifically produced field conditions. For mercury-in-air levels from 0.02 to 0.04 mg Hg/m^3, all five test sorbents and accompanied analytical procedures were in basic agreement. The carbon sorbent results were more erratic, due to the flame atomic absorption detector saturation and the presence of organic vapors. The $KMnO_4$ and IC1 solution sorbents are not convenient for personal monitoring since they are liquids. The silver wool sorbent procedure is a reliable method for mercury-in-air determination; however, the capacity is significantly lower than that for the other four test methods. When the testing load is heavy and the only assessment is compliance to a fixed level, then the carbon tube method is economically attractive because it is fast. However, one must contend with its lesser reliability due to the possibility of mercury overload on the detector and the fact that there is only one chance to analyze the carbon sample. Overall, hopcalite is the best all around procedure for monitoring mercury-in-air levels. It is amenable to personal monitoring, has a high capacity for mercury, excellent recoveries, and comparable field test results with $KMnO_4$, IC1, and silver wool.

9099 Formation of nitrosamines and nitramines by photooxidation of amines under simulated atmospheric conditions. Grosjean, D.; Van Cauwenberghe, K.; Schmid, J.; Pitts, J.N. Jr. (Univ. of California, Riverside). pp 196-199 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Reactions of sub-ppM levels of di- and tri- ethylamine (DEA and TEA) with ambient levels of NO/sub s/ in air at 20 to 40% RH were studied quantitatively both in the dark and in sunlight in 50 m^3 Teflon outdoor smog chambers. Both DEA and TEA behaved in sunlight like hydrocarbons of high photochemical reactivity (rapid conversion of NO to NO_2 and formation of O_3, PAN, and light-scattering aerosols), and formed large amounts of acetaldehyde (300) and 700 ppB respectively) and a variety of nitrogenous compounds. Under similar conditions, TEA gave DEN in the dark, though at a lower rate and yield than with DEA. However, in contrast to DEA, sunlight accelerated the formation for DEN to a maximum yield of 3 ppB which then decreased, presumably due to concurrent photolysis. N,N-diethylformamide was the predominant nitrogeneous species (21 ppB), and diethylnitramine again was a major product (12 ppB). N,N-diethylaceta- mide, N-ethylacetamide, and an unidentified amide-like compound of molecular weight 87 were also formed. The formation of nitrosamines in the dark is explained by rapid reactions of the amines with the small amounts of nitrous acid initially present. A mechanism for photooxidation is proposed based on well known reactions in photochemical smog, involving a rapid initial OH attack on C-H bonds in TEA and on N-H as well as C-H bonds in DEA. Implications for control of both tertiary and secondary amines in industrial and nearby urban environments containing NO/sub x/ and/or nitrous acid are discussed.

9100 Filtration model for aerosol dry deposition: application to trace metals. Davidson, C.I. (Carnegie-Mellon Univ., Pittsburgh, PA); Friedlander, S.K. pp 200-203 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The physical mechanisms responsible for the deposition of trace metals from the atmosphere were studied. Ambient trace metal deposition was examined in terms of a new model, in which the individual physical processes are accounted for. Deposition velocity curves based on filtration (by convective diffusion and inertial impaction) and sedimentation are constructed. The curves are compared with field measurements of trace metal and condensation nuclei deposition. Accomplishments of this research are thus twofold. First, deposition data and theories were used to derive and test a model which can be applied to the deposition of aerosols in general. The input data needed for this model include the aerosol size distribution, characteristics of the windfield, and characteristics of the surface. Second, the data are useful in predicting the transport and deposition of trace metals of public health interest. The model can be applied to vegetated surfaces where the filtration efficiency of the vegetation is known, and where the windfield is known.

9101 Sedimentation potential: an independent entity. Hemeon, W.C.L. (Hemeon Associates, Pittsburgh, PA). pp 204-205 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Measurement methods in both ambient air and at the source, giving indications of concentration or intensity of sedimentation, are based on a combination of two parameters: weight concentrations, C (e.g. $mgms/M^3$) and aerodynamic particle size properties, i.e., settling velocity, U (e.g. M/min), the product of which gives numbers indicating sedimentation rate. Rate of emission of sedimentation potential is derived from combining sedimentation rate, C.U, with gas flow rate, Q (e.g. M^3/min) and their product Q.C.U. (e.g. M . $Mgms/Min^2$). As indicated by these equations, the acutal measurement of sedimentation rate involves by-passing individual measurements of concentration and of particle size or settling velocity in favor of a direct determination of their product, C.U. Sampling apparatus for source and for ambient air use are described in some actual applications.

9102 Method of quality assuring hi-volume samplers with precalibrated sample filters. Hughes, R.L.; Richardson, R.L.; Ehman, D. (Texas Air Control Board, Austin). pp 214-217 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

In order to increase the audit rate of high volume (Hi-Vol) sampler flow calibrations without greatly increasing manpower or equipment needs, the Texas air Control Board developed a method which employs an acetate sheet (a model sample filter) as a flow

restriction device. The flow through the sheet on a given sampler can be predicted from a normal Hi-Vol calibration curve...thus a method for checking the accuracy of flow rate calibrations, requiring only that the model sample filter be placed on the Hi-Vol, and the resultant flow recorded. No other equipment or special training is needed to conduct this test in the field. The method is inexpensive, compact enough to be mailed, and requires minimal training.

9103 Maintaining calibration of long term satellite monitoring devices as performed on the ozone sensing BUV instruments. Guenther, B. (National Aeronautics and Space Administration, Greenbelt, MD). pp 218-221 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Optical instruments exhibit long term degradation effects in space. Global monitoring of stratospheric parameters must be performed by remote sensing from space with optical instruments; however, accurate, time varying calibrations for these environmental monitoring systems must be known if long term trends in the data are to be properly interpreted. Maintaining calibration of such systems provides a heretofore unique problem in environmental monitoring since satellite sensors cannot be returned to the laboratory for regular calibration checks. Several potential calibration updating techniques for these sensors are reviewed. A calibration update of a satellite-borne instrument by deploying a freshly calibrated sensor on board a second satellite to provide overlapping data with a system that had been in operation for more than 5 years. THe Nimbus 4 BUV (Backscattered Ultraviolet) instrument was checked aginst an Atmosphere Explorer 5 BUV launched in November 1975. The problems encountered in this exercise are discussed and then generalized to establish an initial checklist for future calibration experiments of satellite sensors using space shuttle-borne sensors. The difference between sensor calibration and experiment verification is emphasized. The results of verification of the first year of Nimbus data with the Dobson network are reviewed.

9104 Texas co-location program: a comparison of the particulate data from six local agencies and the Texas Air Control Board. Ehman, D.L.; Richardson, R. (Texas Air Control Board, Austin). pp 222-225 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The principal objective of this study was to identify and correct system-wide high-volume air sampler (hi-vol) problems which may exist for the Texas Air Control Board (TACB) and for six local Texas air pollution control agencies participating in the test. The method chosen for the identification of any possible problems was to compare the results from co-located (side-by-side) hi-vols. Each co-location site had one TACB hi-vol paired with either another TACB hi-vol or a local agency hi-vol. The results of this study showed that in 1976 the repeatability (TACB vs TACB) of the hi-vol method for particulates was good, but the reproducibility (TACB vs local agency) of the method was poor. However, in 1977, with better quality assurance techniques (more frequent hi-vol flow rate audits, better training of hi-vol operators and calibrators, and strict standardization of procedures for all agencies), the repeatability of the method has remained relatively good, and the reproducibility of the method has markedly improved. The implication is that interagency comparisons of particulate data must be undertaken with extreme caution, even when no procedural differences are evident.

9105 Environmental data base management at the federal level. Bosch, J.C. Jr. (Environmental Protection Agency, Research Triangle Park, NC). pp 232-234 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Six years of experience in designing, implementing, and managing EPA's National Air Data Systems are condensed into a framework of concrete principles applicable to environmental/energy data base management in general. The roles and interactions of engineers, technicians, and computer system analysts are evaluated along with appropriate management tools available to the data base administrator (i.e., program design specifications and documentation standards). The values of standardized user manuals, forms, processing procedures, and data-retrieval reports are presented both in terms of EPA's experience and their possible application to other large data bases in the environmental/energy fields. Audit-trails and error-correction procedures are also reviewed as part of an overall quality assurance program, which is vital to any complex data system.

9106 Mexico's data management system. Lopez de Alba, F. pp 235-237 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

An inexpensive, yet highly reliable data management system is described. It will be used in establishing an air pollution control program and for establishing air quality standards. This system, then, is used first in helping to decide what type of monitoring system is technically and economically most adequate in a region and later to monitor control strategies.

9107 Design of the organics analysis in an environmental monitoring system. Budde, W.L.; Eichelberger, J.W. (Environmental Protection Agency, Cincinnati, OH). pp 241-243 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Several recent Federal laws dealing with the environment require extensive measurements of the presence and concentration of a broad variety of toxic and persistent organic compounds. Because of the new legal requirements, the design of organics analysis will become a far more significant aspect of an environmental monitoring system than it was in the past. The design of the organics analysis is discussed in terms of a classification of environmental systems, analytical goals, sample preparation and separation methods, and compound recognition and measurement methods. Analytical method selection guidelines are presented in terms of these classifications with comments on the advantages and disadvantages of each.

9108 Application of a methodology for the design of a carbon monoxide monitoring network in the Las Vegas Valley, Nevada. Behar, J.V. (Environmental Protection Agency, Las Vegas, NV); McElroy, J.L.; Dunn, L.M.; Lem, P.N.; Liu, M.K. pp 244-249 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

An objective methodology that uses aerometric data and a physically based mesoscale air quality simulation model has been proposed for the optimal siting of air pollutant monitoring stations in urban areas. The application of the proposed methodology to the Las Vegas Valley are is described. The exercise of validating the Atmospheric Pollution Simulation Model is discussed. The second part describes the selection of meteorological scenarios associated with high pollution potential in the Las Vegas Valley and presents the results of the application of the siting methodology. A key feature of this methodology is the concept and calculation of a Figure of Merit for general air quality monitoring. This index represents an average pollutant concentration at each grid cell as weighted by the frequency of occurrence of the relevant meteorological scenarios.

9109 Monitoring air quality from satellites. Parmenter, F.C. (National Oceanic and Atmospheric Administration, Washington, DC). pp 254-257 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Geostationary orbiting satellites operated by the National Oceanic and Atmospheric Administration (NOAA) provide continuous monitoring of the atmospheric environment. Since air quality is interdependent on meteorological conditions, one can use this satellite data to monitor weather system that signal improving conditions. Smoke, airborne volcanic material, smog and haze, and dust are the most frequently observed phenomena in satellite imagery. The data provides a graphic display of the areal coverage of aerosols and thus some information on source points and trajectories. It also can be used to assess the role of pollution in regional cloud and weather modifications.

9110 Satellite remote sensing for smoke plume definition. Alfoeldi, T.T. (Canada Centre fo Remote Sensing, Ottawa, Canada). pp 258-261 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

LANDSAT satellite imagery provides a unique vantage point for observing and measuring smoke plume travel and distribution. The geometric parameters and diffusion characteristics of a plume, which are impractical to define from the ground, may be objectively determined using digital satellite data. An interactive digital analysis system, the General Electric IMAGE-100 at the Canada Centre for Remote Sensing, was used to develop techniques of smoke plume definition. It is shown to be possible to establish quantitatively the lateral and transverse extent (and diffusion) of the plume, as well as its source, and geographical location. These factors are of interest especially for legal considerations. Methods are illustrated for suppessing the background clutter of high (spatial) frequency patterns of land use and vegetative cover, and enhancing the smoke plume. The

wavelength-dependent absorption by the particulate and aerosol content of the plume is the basis for the technique. As well, multi-temporal or change-detection methods are described.

9111 Evaluation of satellite-borne remote sensors for stratospheric pollution measurements. Keltz, E.L.; Friedman, E.J.; Camichael, J.J. (MITRE Corp., McLean, VA). pp 266-271 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The primary objective of this study was to develop a method for evaluation of the capability of selected spacecraft orbit/remote sensor combinations to provide required measurements of important stratospheric trace constituents in both the ozone and the aerosol chemistry chains. Based on an analysis of present knowledge of the physical and chemical properties of the stratosphere, a prioritized list of required measurements was developed. Four remote sensors under development by NASA and at present considered to be suitable for space flight in the next decade were evaluated for their applicability to stratospheric measurements. These candidate sensors were compared with the prioritized list of measurement requirements and with orbital constraints imposed by one sunsynchronous orbit and two possible Shuttle mission orbits (30° and 56°). A method is presented which evaluated a selected mission in terms of the present status of knowledge of the trace constituents and the priority and level of measurement requirements. Results of the study confirm the relative superiority of limb-viewing instruments for a stratospheric measurement program. It was also shown that for all but one of the eleven orbit/instrument missions examined a 56° orbit is seen capable of satisfying the greatest number of scientific requirements.

9112 Statistical sampling analysis for stratospheric measurements from satellite missions. Drewry, J.W. (National Aeronautics and Space Administration, Hampton, VA); Harrison, E.F.; Brooks, D.R.; Robbins, J.L. pp 272-278 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Earth orbiting satellite experiments can be designed to measure stratospheric constituents such as ozone by utilizing remote sensing techniques. Statistical analysis techniques, mission simulation, and model development were utilized to develop a method for analyzing various mission/sensor combinations. Existing and planned NASA satellite missions such as Nimbus-4 and G, and Stratospheric Aerosol and Gas Experiment -Application Explorer Mission (SAGE-AEM) were analyzed to determine the ability of the missions to adequately sample the global field.

9113 Some problems of remote sounding of gaseous atmospheric pollutants. Zuev, V.E.; Samokhvalov, I.V.; Sosnin, A.V.; Khmelnitski, G.S. (Inst. of Atmospheric Optics, Tomsk, USSR). pp 279-280 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Among the methods based on differential absorption the following three methods can be distinguished as being useful for remote sounding of the atmospheric pollutants: a long path absorption method, a method of laser sounding of topographic targets, and an aerosol backscattering method. Use of the information-metric approach enables one to construct a limiting capabilities scale for each measurement procedure. The construction is based on a quantitative measure of distinguishability of the states characterized by two parameters for a given reliability named as an information distance. The calculation made for the long path absorption method and the method of aerosol backscattering and topographic targets sounding has shown a limiting accuracy of gas concentration measurement in the first method to be higher than that in the second one; the first method is easily optimized. The effect of aerosol attenuation and foreign gas absorption which considerably decreases the concentration measurement has fist been taken into account.

9114 Model to predict violation of clean air regulations. Kumar, A.; Djurfors, S.G. (Syncrude Canada Ltd., Edmonton, Alberta). pp 281-288 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A $2 billion plant is being built to extract oil from the Athabasca Tar Sands. The plant will begin production in 1978 and will be permitted to emit 287 tons of SO_2/day. Under certain atmospheric conditions (e.g. limited mixing), the legal limits for maximum ground level concentration (glc) may be exceeded. The ability to predict such violations is important. A model for predicting violations of the Clean Air Act from an industrial source is described. The model consists of three different phases: prediction of the development of the thermal boundary layer, prediction of the plume rise, and calculation of ground level concentration. The integrated computer package generates information on maximum glc vs time of day and issues a violation warning when appropriate. The minimum data requirements consist of: height of boundary layer; (potential) lapse rate above inversion layer; mean wind speed and atmospheric temperature; and the operating characteristics of the stack. The effect of the development of the boundary layer, the plume penetration, and the release height on glc may be easily studied using this model. Preliminary results show that these variables should not be ignored while calculating glc in the Tar Sands area.

9115 Theoretical and experimental determination of the efficiency with which aerosol particles are collected by water drops in air due to Brownian motion, phoretic forces, inertial impaction, and electric forces. Wang, P.K.; Grover, S.N.; Pruppacher, H.R. (Univ. of California, Los Angeles). pp 295-300 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Two theoretical models that complement each other and allow computing the efficiency with which aerosol particles of various sizes collide with water drops of various sizes in subsaturated air are described. The first model, applying to relatively large particles, is based on a trajectory method and considers the simultaneous effects of inertial impaction, phoretic, and electrical effects. The second model, applying to relatively small particles, considers the simultaneous effects of Brownian diffusion, phoretic, and electrical effects. The results of both models are compared with the results of an experimental study carried out in the UCLA 35 m Rainshaft which allows determining the collection efficiency of drops for aerosol particles under controlled electrical, temperature, and humidity conditions.

9116 Regeneration of the atmospheric water vapor concentration profile from lidar measurements. Zuev, V.E.; Ivanenko, B.P.; Marichev, V.N.; Natta, I.E.; Samokhvalov, I.; Sosnin, A.V. (Inst. of Atmospheric Optics, Tomsk, USSR). pp 301-302 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The methods and some results of regeneration of the atmospheric water vapor concentration profile obtained from lidar signals by the differential absorption method are presented. In this case the unknown N(R) concentration is determined. The problem of experimental data interpretation results in the necessity of differentiation of empirical functions which is an incorrect problem and requires the application of regularizing algorithms. The derivative U(R) of the function U(R) is the solution of an integral Fredholm equation of the first type. The results of regeneration of lidar signal logarithmic derivatives and the results of numerical experiment illustrating stability of this differentiation method in the presence of measurement error are presented.

9117 Clean air convective structure observed by lidar. Kunkel, K.E.; Eloranta, E.W.; Shipley, S.T.; Weinman, J.A. (Univ. of Wisconsin, Madison). pp 303-306 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A scanning lidar system was used to observe convection in the atmospheric boundary layer. In particular, cell sizes and geometry were determined and circulation patterns in and around the cells were measured. The lidar data show that the preferred form of convective cells are plumes rather than bubbles with roots near the surface. The majority of these plumes have aspects ratios between .5 and 1.5. The measurements of circulation patterns show the strongest rising motion on the upwind side of the cell with sinking motion on the downwind side. These observations show that lidar is a powerful tool for observing convection in the boundary layer.

9118 Global sensing of gaseous and aerosol trace species using automated instrumentation on 747 airliners. Perkins, P.J.; Papathakos, L.C. (National Aeronautics and Space Administration, Cleveland, OH). pp 307-312 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The Global Atmospheric Sampling Program (GASP) operated by NASA is collecting and analyzing data on gaseous and aerosol trace species in the upper troposphere and lower stratosphere. Measurements are obtained from automated systems installed on four 747 airliners flying global air routes. Since the introduction of this program in 1975, advances have been made in airborne sampling

instrumentation. Improved instruments and analysis techniques are providing an expanding data base for trace species including ozone, carbon monoxide, water vapor, condensation nuclei and mass concentrations of sulfates and nitrates. Simultaneous measurements of several trace species obtained frequently can be used to uniquely identify the source of the air mass as being typically tropospheric or stratospheric. A quantitative understanding of the tropospheric-stratospheric exchange processes leads to better knowledge of the atmospheric impact of pollution through the development of improved simulation models of the atmosphere.

9119 Analysis of the first two years of GASP data. Holdeman, J.D. (National Aeronautics and Space Administration, Cleveland, OH); Nastrom, G.D.; Falconer, P.D. pp 313-317 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Distribution of mean ozone levels from the first two years of data from the NASA Global Atmospheric Sampling Program (GASP) show spatial and temporal variations in the agreement with previous measurements. The standard deviations of these distributions reflect the large natural variability of ozone levels in the altitude range of the GASP measurements. Monthly mean levels of ozone below the tropopause show an annual cycle with a spring maximum which is believed to result from transport from the stratosphere. Correlations of ozone with independent meteorological parameters, and meteorological parameters obtained by the GASP systems show that this transport occurs primarily through cyclogenesis at mid-latitudes. The GASP water vapor data, analyzed with respect to the location of the tropopause, correlates well with the simultaneously obtained ozone and cloud data.

9120 Suppression effect of CO_2 on FPD total sulfur air analyzers and recommended corrective action. von Lehmden, D.J. (Environmental Protection Agency, Research Triangle Park, NC). pp 361-365 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The suppression in the total sulfur response due to carbon dioxide was measured on flame photometric detector (FPD) total sulfur analyzers. Each analyzer was challenged at the 50, 100, and 150 ppB SO_2 level using air containing 0, 360, and 750 ppM CO_2. Four different models of FPD total sulfur analyzers were evaluated. Six or more analyzers were evaluated for each model. Suppression in analyzer response due to CO_2 was observed in all four models at all three SO_2 levels. At each monitoring project, ambient air is scrubbed and used as the dilution air during a multipoint calibration. Simultaneous measurements of CO_2 in the ambient air and CO_2 in the scrubbed calibration air showed partial and variable removal of CO_2 by the scrubbing system. At EPA monitoring Project No. 1, simultaneous measurements of CO_2 in the ambient air and in the calibration air were performed at 23 monitoring stations. On an average for the total 23 stations, the CO_2 in the calibration air was 328 ppM lower than that in the ambient air being sampled at the stations. Concern exists that some monitoring networks may be calibrated with calibration air containing low CO_2 and then returned to service to analyze ambient air containing a significantly higher CO_2 concentration. By proper treatment of the calibration air, the CO_2 suppression on FPD total suflur response may be minimized. An activated charcoal scrubber is recommended for proper treatment of the calibration air.

9121 Individual air pollution monitors. Lyshkow, N.A. (Combustion Equipment Associates, Inc., New York, NY); McCormack, C.G. pp 366-369 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

An analysis system was developed for field monitoring of certain pollutants. Prototypes were developed specifically for job safety applications. The analysis system lends itself to a wide variety of uses including personal exposure monitoring with or without alarms. The analysis is based on a measurement of reflectance from a silica gel tape using a light emitting diode light source. Due to the wide variety of light emitting diodes available, a wide range of analyses could be implemented on the system using existing technology for silica gel analysis. Much further development, however, remains. The methodology has been proven to be feasible but improvements in the hardware and a further reduction in size are necessary before commercialization. The electronics of the system could be modified to utilize new micro processors, which were not available at the time of its original design. This would both simplify and greatly reduce the size of the instrument. The analyses are based on known silica gel based analytical procedures and extension of the range of pollutants should not present major difficulties.

9122 Indoor and outdoor sources of particulate air pollution in a residential environment. Moschandreas, D.J. (GEOMET, Inc., Gaithersburg, MD); Burton, R.M.; Courtney, W.J.; Pilotte, J.O.; Winchester, J.W.; Kaufmann, H.C.; Nelson, J.W. pp 370-373 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A program was undertaken to document elemental constituents of suspended particulate matter in homes and schools as a function of time and ambient meteorological conditions, aiming to identify which elements may have significant indoor sources. In a Denver, Colorado single-family house, samples were taken for seven days in October 1976 in the kitchen and at a nearby outdoor location using time sequence filter streaker samplers. A total of 84 2-hourly analyses of each sample were perfomed by proton-induced x-ray emission (PIXE) for S, Cl, K, Ca, Ti, Mn, Fe, Cu, Zn, B, and Pb. Outdoor concentrations of most elements were highest during the first 40 hours of sampling, then low for a four-day period, and again high during the final 30 hours of sampling, apparently reflecting weather changes during the week. Of special interest are Pb and Br which, during the middle four days, had higher indoor concentrations than outdoor. Indoor sources of Pb, with Br/Pb = 0.6, predominated in the middle period, but infiltration from outside sources having Br/Pb = 0.3 predominated in the initial and final periods. A simple mixing model for indoor- and outdoor-generated Pb and B within the house leads to an estimate of 0.3 as the factor by which outdoor lead is reduced in concentration during its penetration indoors.

9123 Technique for work-station monitoring utilizing optical waveguides. Orofino, T.A.; David, D.J.; Hardy, E.E. (Monsanto Research Corp., Dayton, OH). pp 374-376 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A novel monitoring technique based upon changes in properties of an optical waveguide exposed to the workplace atmosphere is described. The basis for the analysis is the partial attenuation of a light signal traversing a small, cylindrical, quartz waveguide by successive total internal reflections. The quartz rod is uniformly coated, except at the ends, with a suitable polymer film which is transparent and contains a dispersion of a chemical reactive toward the atmospheric component of interest. Transport of the component from the surroudning air into the coating is by diffusion, thus obviating the need for pumps and power supplies. The reaction between the component and the coating chemical is selected to produce an optical change in the coating, such as generation of a wave-length-specific color, a change in refractive index, or development of turbidity. The reactions may promote reversible or irreversible optical changes. In the latter case, measurement of light transmission through the waveguide, before and after exposure to the atmosphere for a known period of time, provides a direct measure of time-weighted average concentration. Applications to detection of gases in the vicinity of their TLV values are described.

9124 Evaluating toxic gas hazards inside heavy duty diesel truck cabs. Ziskind, R.A. (Science Applications, Inc., Los Angeles, CA); Carlin, T.J.; Ballas, J. pp 377-383 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

An experimental program was conducted to measure the cab concentrations of several toxic gases throughout a significant cross section of conditions and vehicles comprising heavy duty diesel truck population and use. Ambient and in-cab concentrations were continuously measured for cabon monoxide, nitric oxide, and nitrogen dioxide. Supplemental air bag samples were analyzed for sulfur oxides and total hydrocarbons. These data were used to assess the potential for performance and health degradation due to vehicle selfcontamination. A tracer gas, SF_6, was used to delineate the relative importance of various emission source locations and cab entrance pathways. Eighty-eight tractors were surveyed by idling and/or road tests. Statistical correlation was found between vehicle-induced elevated in-cab concentrations of specific gases and several testing parameters including: condition of windows, type of cab configuration and the presence of exhaust leaks and underside cab openings. Many vehicles were found to have in-cab concentrations of greater than 0.5 ppM NO_2 which is considered by NIOSH to be a significant occupational exposure level.

9125 State of the art in continuous monitoring for toxic substances using chemically impregnated paper tapes: technology and innovations. Moore, G.; Miller, R.W. (MDA Scientific, Inc., Park Ridge, IL). pp 384-387 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The growing interest on the part of industry and government in protecting industrial workers from toxic occupational exposures has high-lighted the need for improved monitoring systems. Several years ago continuous personal and area monitors were developed for a number of contaminants. Based on the well-established principle of a chemically impregnated paper tape specific to a given toxic substance, these systems photoelectrically evaluate the intensity of the stain formed by the reaction of the gas with the chemicals impregnated onto the tape. Aspirated air is continuously drawn through the paper tape as it moves past the exposure orifice. The amount of light reflected from the reference, or unstained portion of the tape as compared to that reflected from the stained section presents a continuous differential signal to the panelmeter and recording instrument. Audio and visual alarm capabilities are designed into the system and preset to indicate when toxic concentrations exceed the permissible level. Refinements and improvements in the original design have produced maximum sensitivity as well as a continuous, minute-by-minute record of concentration over time. Higher sensitivity in the lower ranges is possible because the signal output is semi-logarithmic; specificity is guaranteed by the chemical formulation of the tape. The concentration/real time data generated is presently processed by newly developed optical systems and linearizing circuits which translate the basic information into total dose and time weighted average documentration. These innovations have raised the sophistication level of the tape technique from discontinuous, non-specific monitoring which produced basic data, to a complex, coordinated detection system which provides sampling, chemical analysis and data processing in one integrated design. The result is precise data on employee exposures and contamination of ambient air for recordkeeping and compliance purposes.

9126 System for a nitric oxide dosimeter: a free radical reagent on silica gel. Nadeau, J.S.; Boocock, D.G.B. (Univ. of Toronto, Ontario). pp 388-389 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

An organic stable free radical was incorporated as reagent in a time averaging monitor for nitric oxide. The reagent is adsorped on thin layer silica gel plates and covered with a silica-filled polymethyl-vinylsiloxane membrane reinforced with a polyester knit. The composite is then exposed to the nitric oxide atmosphere of interest. Nitric oxide permeates the mambrane to the reagent and reacts to produce a product radical and nitrogen dioxide. The product radical is extracted with dioxane and an electron spin resonance spectrum is taken. From this, the time weighted average concentration may be determined. Concentration as low as 0.01 ppM nitric oxide may be measued in a one hour period. Use of more resistive membranes is required for measurements of higher nitric oxide concentrations over longer sampling periods used for dosimeters.

9127 Personal air quality monitors: past uses and present prospects. Wallace, L. (Environmental Protection Agency, Washington, DC). pp 390-394 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Use of personal air quality monitors in measuring the exposure to air pollution of the general public are explored. Advantages to the epidemiologist and to the environmental manager are described. Studies indicating the desirability, utility, and feasibility of personal monitors are referenced. Present industrial capabilities and Federal agency activities are surveyed. The conclusion is reached that sufficient progress in personal monitor development has been made to warrant evaluation of existing monitors to determine their suitability of existing monitors to determine their suitability for environmental studies. It is also concluded that population studies using existing personal monitors could be expected to give valuable information on the exposures of entire urban populations. Finally, for some pollutants not now detectable at ambient levels by personal monitors, increased support for research and development would probably produce working prototypes within three years.

9128 Lidar remote sensing of tropospheric pollutants and trace gases: programs of NASA Langley Research Center. Browell, E.V. (National Aeronautics and Space Administration, Hampton, VA). pp 395-402 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The Differential Absorption Lidar (DIAL) research program include the development and evaluation of a uv DIAL system for remote measurements of SO_2 and O_3 concentrations and aerosol dispersion in urban and power-plant stack plumes, a near-IR DIAL system for vertical measurements of water vapor concentrations, and a high-power, tunable IR DIAL system which will measure the concentration of gas species that have absorption features in the 1.4 to 4.4 μm wavelength range. The lidar programs which deal with aerosol measurements include the evaluation of a mobile ruby lidar system for use in plume dispersion model verification and the development of a high-spectral-resolution lidar system for measurement of aerosol extinction and backscattering coefficients. System characteristics and measurement sensitivities are discussed, and comparisons are made between simulations and experimental results.

9129 Measurement by Doppler lidar of atmospheric velocities relevant to environmental monitoring. Schwiesow, R.L.; Post, M.J.; Derr, V.E. (National Oceanic and Atmospheric Administration, Boulder, CO). pp 403-406 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

An infrared, Doppler lidar system was used to measure velocities in the atmosphere. Applications to air quality problems for which the Doppler lidar is being evaluated include measurements of atmospheric diffusion, stack effluent velocity, and structural loading from the localized winds of vortices,and determination of the urban ventilation factor. The Doppler lidar measures the line-of-sight component of the velocity of aerosols in its sensing volume. Properly applied, it can measure wind profiles to at least 300 m altitude at a distance of up to 1 km fom the lidar, sub-resolution-volume scale turbulent, and 10.6 μm backscatter intensity. The Doppler lidar system acts as a vertical anemometer array and is completely mobile. Profiles obtained from variable range or variable elevation scans apply to diffusion and ventilation problems. Considerations of data interpretation for stack effluent velocity have dictated refined Doppler approaches. Better signal-to-noise ratio in data processing, development of a differential Doppler technique, and use of Doppler lidar to measure plus and minus velocity are improvements under way.

9130 Lidar observations of the density and behavior of the Labadie Power Plant plume. Uthe, E.E. (SRI International, Menlo Park, CA); Wilson, W.E. pp 407-415 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

As part of Project MISTT (Midwest Interstate Sulfur Transformation and Transport), the SRI mobile Mark IX lidar system was used to derive information on the particulate density distribution and behavior of the Labadie Power Plant plume, near St. Louis, MO, at distances up to 130 km downwind from the plant site. Digital data recording, processing, and TV-type display techniques were used to provide real-time information on the location and structure of the particulate plume. Subsequent digital analyses have provided estimates of plume density, distributions, and other important plume parameters. Data examples illustrate the unique capability of a mobile lidar system for tracking plumes to long downwind distances during stable nighttime conditions, observing plume cross-sectional structure by scanning in elevation with a stationary lidar, observing changes in plume characteristics during the transition from stable nighttime conditions to unstable daytime conditions by operating a vertically pointing lidar along a cross-plume mobile route, and deriving cross-plume mass concentrations by using available information on particle size distribution and background aerosol mass concentration.

9131 Measurements of source emissions and ambient air quality using pulsed nitrogen and dye lasers. Fredriksson, K.; Lindgren, I.; Svanberg, S. (Chalmers Univ. of Tech., Goeteborg, Sweden). pp 416-419 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A lidar system for the study of atmsopheric pollutants was constructed and tested. A dye laser pumped by a nitrogen laser and a flashlamp-pumped dye laser are incorporated in the system. A 25 cm diameter telescope is used as a receiver. The telescope, that has its axis parallel to the laser output beam, may be directed via a computer, which also sets the laser wavelength. Measurements are made in a signal-averaging process, and calculations are made in real time by the computer. The methods used for measurements of molecular constituents are based on the DIAL technique, whereas other studies are made using mainly elastic but also Raman scattering. Studies of smoke-stack emissions were made for particles and the gases NO_2 and SO_2 at different industrial plants. Plume-spreading studies of very faint plumes were performed. NO_2 and SO_2 were further studied in an urban atmosphere.

9132 Airborne laser absorption spectromter: a new instrument or remote measurement of atmospheric trace gases. Shumate, M.S.; Menzies, R.T. (California Inst. of Tech., Pasadena). pp 420-422 of

Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The Laser Absorption Spectrometer is a portable instrument developed by JPL to remotely measure trace gases from an aircraft platform. It contains two carbon dioxide lasers, two optical heterodyne receivers, appropriate optics to aim the lasers at the ground and detect the backscattered energy, and signal processing and recording electronics. Operating in the differential absorption mode, it is possible to monitor one atmospheric gas at a time, and record the data in real time. The system can presently measure ozone, ethylene, water vapor, and CFM's with high sensitivity. Aiborne measurements were made in early 1977 from the NASA/JPL twin-engine Beechcraft, and in May 1977 from the NASA Convair 990 during te ASSESS-II Shuttle Simulation Study. These flights resulted in measurements of ozone concentrations in the lower troposphere which were compared with ground-based values provided by the Air Pollution Control District. Details of the instrument and results of airborne measurements are described.

9133 Circumsolar measurement program: assessment of the effects of atmospheric scattering on solar energy conversion. Hunt, A.J.; Grether, D.F.; Wahlig, M. (Univ. of California, Berkeley). pp 423-426 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Circumsolar radiation is produced by small-angle scattering of sunlight from atmospheric aerosols with dimensions larger than the wavelength of light. These aersols can sometimes deviate a significant amount of light outside the acceptance angle of highly concentrating solar collectors. The primary purpose of the project is to assess the impact of the aerosol scattering on focusing collector systems. Four automatic telescopes have been built and are providing detailed intensity vs angle profiles of the light from the solar and circumsolar region of the sky. The instruments provide wavelength-dependent forward scattering data from several diverse locations. The telescopes function completely automatically. They acquire and track the sun, scan the sky within +/-3 degrees from the center of the sun, furnish normally incident and total solar insolation data, and record these data along with weather information on magnetic tape. The weekly data are gathered at LBL, edited, abstracted, and condensed onto a single magnetic tape per year for each telescope. The yearly tapes will be available to investigators interested in studying the scattering properties of the atmosphere. Sample data are given for several locations and atmospheric conditions. Statistical summaries are presented to indicate the amounts of circumsolar radiation and the resulting impact of atmospheric scattering on various types of solar collectors.

9134 Photochemical box model for urban air quality simulation. Schere, K.L.; Demerjian, K.L. (Environmental Research Center, Research Triangle Park, NC). pp 427-433 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A simple box-approach to air quality simulation modeling has been developed in conjunction with a newly formulated photochemical kinetic mechanism to produce an easily applied Photochemical Box Model (PBM). This approach represents an urban area as a single cell 20 km in both length and width and with a variable height representing the changing depth of the mixed layer. Each pollutant species being simulated is accounted for in the model by an ordinary differential equation composed of advective, volume expansion, chemical, and emissions (if any) terms. Initial development and testing of the PBM has drawn upon the RAPS data base, a comprehensive set of meteorological and air quality data for St. Louis, MO. One-minute averaged solar radiation data are used in the computation of the photolytic rate constants for the model. Hour-averaged winds and air quality data are utilized in initial and boundary condition calculations as well as providing the observed values for use in model validation. The upper and lower bounds on the mixed layer depth are deduced from RAPS rawinsonde data. Finally, model predictions from the PBM are examined and compared to the observed data on selected days. Application of the model for prediction of oxidant levels in urban areas is discussed.

9135 Pattern recognition methods and air pollution source identification. Leibecki, H.F.; King, R.B. (National Aeronautics and Space Administration, Cleveland, OH). pp 434-437 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Samplers (Air Scouts) capable of resolving suspended particulate matter according to wind direction (source) and time were utilized in a progam to determine the feasibility of empirically characterizing and identifying specific emisson source types in an urban multi-source area. The samplers were operated from January through September in 1976. Four hundred eighty-seven filters, selected on the basis of weather and wind direction criteria, were analyzed for 16 elements using low-cost x-ray fluorescence techniques to provide elemental concentrations for each of the 8 sampling directions. Data for precision determination was collected at 2 locations using 2 Air Scouts at each site controlled by a single sensor. A coefficient of variation of 25% was found. Two-way analysis of variance determined that there was a significant difference in the elemental concentrations for direction, day, and interaction of direction and day. Methodology for analysis of the data using parametric and non-parametric methods was developed using a site characterized by heavy industry and mixed residential-industrial. The data when suitably treated gave a pattern which showed combinations among 8 elements capable of differentiating the 3 industrial directions from the other 5 and from each other.

9136 Statistical distribution of air contaminant levels due to constant point sources. Hardison, L.C. (Air Resources, Inc., Palatine, IL). pp 438-442 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Observed frequency distributions for ambient air contaminant levels which can be attributed to prominent stationary sources are not ordinarily log normal normally distributed as has been reported in the literature. Both dispersion modeling and monitoring produce similarly shaped frequency distribution curves which suggest that maximum annual values based on log normal projections will be much higher than actual observations. Some examples of field observations of air quality data attributable to a single source or a group of sources and corresponding dispersion modeling data are presented and discussed. A rationale is proposed to account for the shape of the probability distribution curves, and a method for estimating maximum annual concentrations from monitoring progrrams of limited duration is presented.

9137 Identification of aerosol sources in the St. Louis area using factor analysis. Gatz, D.F. (Illinois State Water Survey, Urbana). pp 443-445 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Decisions on controlling emissions to reduce atmospheric aerosol concentrations require accurate information on ambient concentrations, composition, and sources. Proper filter sampling of ambient aerosols followed by multi-element analysis of the filters and factor analysis of the data, can identify sources. Additional methods are available to estimate their relative contributions. Nearly 400 filters, collected at 12 sites in the St. Louis area from 1973 to 1975 as part of project METROMEX, were analyzed by ion-excited x-ray fluorescence for 10 to 20 elements. Factor analyses were performed separately for each site, revealing a number of common area-wide sources and several local sources. Widespread sources include soil dust and/or flyash, secondary sulfates, auto exhaust, and metals. Local sources identified include a titanium pigment plant and a secondary lead smelter. This technique of source identification could be improved by taking shorter samples, separated into 2 or 3 size classes.

9138 Interpolation procedures fo the improvement of air pollutant time-averages. Graves, M.E. (Northrop Services, Inc., Research Triangle Park, NC); Wagstaff, R.L.; Rhodes, R.C. pp 446-450 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Gaps in stored air pollution data records are deleterious to time-averages, inflating their error or even precluding their computation under established criteria. The effects of simulating missing data values from complete data sets are studied, taking time-averages over periods from 10 min to a year. To improve the time-averaged values, four interpolation methods-linear, quadratic, harmonic analysis, and bootstrapping-are tested as techniques to fill in data gaps created by random deletion and sequential deletion procedures. Probability intervals for the computed time-average values are presented along with systematic error charts and empirical diagrams depicting the performance of the various interpolation schemes. Corresponding confidence intervals for the true time-average values are determined. An important conclusion is that interpolation is a feasible technique to fill in missing data values. Linear interpolation, in particular, is an effective method at all of the time-averaging periods studied. Bootstrapping is also an effective method, but it requires prior knowledge of the data patterns.

9139 Development of a pollutant monitoring system for biosphere reserves and results of the Great Smoky Mountains Pilot

Study. Wiersma, G.B.; Brown, K.W.; Crockett, A.B. (Environmental Monitoring and Support Lab., Las Vegas, NV). pp 451-456 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A concept paper dealing with the development of multimedia pollutant monitoring systems on biosphere reserve sites is presented. It includes a review of the development and need for biosphere reserves. Items discussed are sample site selection criteria, including topographical conditions, soils, continuity, access, and vegetation types, site size, the use of remote sensing techniques, and statistical considerations. Results of a presampling study at the Great Smoky Mountains biosphere reserve and analytical results for the air, soil, vegetation, and water samples obtained in this initial study are presented.

9140 Mexican Air Control Laboratory. Tolivia-Melendez, E. pp 458-459 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The organization and installation of an Air Control Laboratory are important steps toward the implementation of an air pollution control program. One of the main objectives of the Air Control Laboratory is to provide support for research work in several areas of atmospheric pollution. It should provide analytical services for the air pollution monitoring network and for sampling of sources, and, it should assume the responsibility for the quality assurance of the data acquired. The Mexican experience is an interesting example for other nations in the development stage with interest in protecting its environment, because the Air Control Laboratory has been arranged as an integrated laboratory for quality control, gas and particle analysis and other specific studies on air pollution.

9141 Evaluation of instruments and measurement strategies for airborne remote sensing of regional air pollution measurement requirements. Keitz, E.L.; Friedman, E.J. (MITRE Corp., McLean, VA). pp 460-463 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The application of air borne remote sensors of air pollution to the regional problem was studied. The performance of such instruments is contrasted with that expected from both ground-based monitors and airborne contact sensors. The study includes evaluation of measurement strategies for the long range transport of both an urban oxidant plume and a fossil-fueled power plant sulfur dioxide/sulfate plume. Aspects of the problem which are dealth with include: measurement requirements, the current status of specific remote sensors and a five year outlook for selected techniques. It is concluded that several of the remote sensors should be capable of being used in a regional monitoring system within the next five years if development proceeds as expected. These include an infrared LIDAR, a gas filter correlator, and a laser absorption spectrometer. Evaluation of the measurement strategies shows that although an airborne remote sensing system cannot provide significantly more required data than an airborne contact system, it does so with fewer aircraft, fewer instruments and in a much less complex manner.

9142 So you're going to build an environmental laboratory. Regnier, J.E. (Environmental Health Administration Lab., Montgomery, AL); Rosa, F.Y. Jr. pp 464-466 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Practical information is provided to the laboratory manager faced with the responsibility of developing new environmental laboratory facilities. The Alabama Department of Public Health has recently initiated construction of an environmental laboratory in which chemical and radiological determinations required by Department programs will be perfomed. The phases of this facility development from site selection through architectural services, design, and construction are described with particular emphasis on the relation of design parameters to pollutant measurement requirements. The costs of the construction are presented and discussed in terms of areas in which savings can be most effectively achieved.

9143 Source emissions factors for refuse derived fuels. Carroll, J.M. (Standard Oil Co., Cleveland, OH); Hall, J.L.; Joensen, A.W.; VanMeter, D.B. pp 472-478 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

In 1976 an alternate method of determining emissions was accepted as a Federal Standard. This alternate technique required measurement of only the effluent concentration and use of emission factors (F or F/sub c/) for the particular fossil fuel being used. The emission factors were found to be constants for any given fossil fuel type (coal, oil, gas). This study was an extension of the alternate technique where processed refuse or refuse derived fuel (RDF) is used as a supplement to other fossil fuels n a steam generating unit. Comparisons of the results have been made for particulate emissions during the use of RDF as a supplementary fuel with coal in the City of Ames (Iowa) municipal power plant. The maximum uncertainty was found to be 3.0% for a typical F-factor and 2.4% for a typical F/sub c/-factor for the refuse derived fuels. A linear correlation of the emission factors for refuse derived fuels was found as a function of percent by weight for carbon on an ash and moisture free basis. F-factors had higher correlation coefficients and more data points within 95% confidence bounds than the F/sub c/-factors. A comparison between emission factor methods and direct sampling methods for calculating volume of effluent produced per million Btu of heat energy input (Q/sub s//Q/sub h/) was also accomplished. Both emission factor methods (F and F/sub c/) values of Q/sub s//Q/sub h/ were found to be in the same relationship (either higher or lower) as compared to the direct method value. The F/sub c/-factor method values of Q/sub s//Q/sub h/ were found to be higher than the F-factor method values. The direct sampling method values of Q/sub s//Q/sub h/ were within 25% of the emission factor methods for all tests. The maximum uncertainty was found to be 2.6% for a typical F-factor method value of Q/sub s/Q/sub h/ and 2.2% for a typical F/sub c/-factor method value of Q/sub s//Q/sub h/.

9144 Monitoring of combustion gases during thermal destruction of hazardous wastes. pp 482-486 of Fourth joint conference on sensing of environmental pollutants. Clausen, J.F. (TRW DSSG, Redondo Beach, CA); Zee, C.A.; Adams, J.W.; Harris, J.C.; Levins, P.L. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

An area of great concern to many environmentalists is the problem of waste disposal and especially the disposal of hazardous or toxic waste materials. Among the promising methods being investigated is thermal destruction. Organic industrial wastes were thermally destroyed in commercial-scale disposal facilities. As part of the evaluation of each system, hot combustion gases were extracted during the tests and continuously monitored for several gaseous components. Because of the corrosive nature of these combustion gases, a gas conditioning system was first designed to dry and cool the gas stream, and to remove particulate matter. Monitoring instruments were then selected that could withstand the moisture-free acid gas environment. This monitoring system was installed in a mobile van, operated for two years at sites throughout the country, and yielded very good results. The continuous, on-line monitoring data provided useful indication of steady-state conditions and any potentially hazardous emission levels, and could signal process fluctuations in a timely fashion so that they could be corrected before serious amounts of pollutants were emitted to the atmosphere.

9145 Monitoring the disposal of hazardous materials. Colburn, E.F. (Chemical Systems Lab., Aberdeen Proving Ground, MD). pp 489-492 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The Army is now engaged in demilitarization and disposal of obsolete toxic chemical agents and chemical munitions. In the past, these materials would have been open-pit burned, buried, or ocean dumped. As a result of congressional actions and subsequent environmental restrictions, the old methods for disposal of chemical agents have been abandoned. Techniques are now being developed which meet the designated criteria of total containment and zero release to minimize the impact of the environment. Chemical neutralization and conventional incineration are two of the primary demilitarization processes under consideration. Some of the unique problems encountered in designing and developing these processes are addressed, in particular to dispose of chemical agent identification and training sets in an environmentally acceptable manner. These sets, which are now obsolete, contain various combinations of chemical warfare agents that were used for training servicemen in their identifications. Emphasis will be on the rationale behind and development of a detection and monitoring system capable of detecting low concentrations of each agent in mixtuees of off-gases to insure that this disposal is achieved without violating any of the established air quality standards or environmental criteria. Other key areas to be discussed are: system and process design to insure containment and development of emission limits for agents for which no standard exist and only limited toxicology data are available.

9146 Trace elements and sulfur in soils and plants near the Mohave Generating Station in southern Nevada. Strojan, C.L.; Turner, F.B. (Univ. of California, Los Angeles). pp 537-540 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Concentrations of Cu, Ni, Pb, S, Sr, and Zn were measured in soil and plant samples at distances of 2, 4, 6, 8, 12, 16, and 20 km downwind from the coal-burning Mohave Generating Station in southern Nevada. Concentrations of all elements except Sr were significantly higher in surface (0 to 2 cm) than in subsurface (10 to 20 cm) soils. Significant decreases with distance from the power plant were found for Cu, S, and Sr in surface soils, S and Sr in subsurface soils, S in Ambrosia dumosa leaves, and Cu in Larrea tridentata leaves. Estimated fly ash deposition during the six-year operating life of the generating station is apparently too low to account for measurable increases in soil elemental concentrations except for sulfur. Dispersion-model calculations and field measurements both indicate that amounts of sulfur deposited from the power plant during this time may approach natural levels in surface soils.

9147 Remote sensing of gaseous pollutants by infrared absorption and emission spectroscopy. Herget, W.F.; Powell, D.D. (Environmental Protection Agency, Research Triangle Park, NC). pp 541-544 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Ground based remote measurements to determine the identity and concentration of gaseous pollutants emitted by various stationary sources are being carried out using a high resolution (up to 0.07 cm^{-1}) infrared spectrometer system. This system, which utilizes a Fourier-transform interferometer to cover the 1.7 to 15 micron spectral region, was installed in a van and can be used in the long-path absorption mode with a remote light source, or in the single-ended mode to observe emission signals from gases at elevated temperatures. All components necessary to obtain plotted spectra in the field are contained in the van. Recent measurements have been conducted at phosphate fertilizer plants to characterize the gaseous fluoride emissions from gypsum ponds and at an airport to characterize jet engine emissions. The fluoride emissions were found to consist primarily of HF (on the order of 50 ppB). Absorption spectra of jet engine plumes showed, in addition to CO and CO_2, continuum absorption due to hydrocarbons between 2800 and 3100 cm^{-1} and line absorption due to formaldehyde.

9148 Millimeter wavelength spectroscopy of trace atmospheric constituents from the five college radio astronomy observatory. Huguenin, G.R.; Irvine, W.M. (Univ. of Massachusetts, Amherst). pp 545-547 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Microwave and millimeter wave observations of trace upper atmospheric constituents have been made for O_3 (emission and absorption at 110.8 GHz, H_2O (emission and absorption at 2212 GHz) and CO (absorption at 115.3 GHz). Ozone should be (by almost an order of magnitude) the easiest trace constituent to detect, and measurements of diurnal variations during February 1975, were reported. The water vapor measurements suggest a mesospheric mixing ratio a factor of two larger than the maximum predicted by photochemical equilibrium calculations for spring-summer at mid-latitudes (in 1975), and should be repeated for verification as well as extended over a larger time base. The CO results provide new infomation on vertical transport in the mesosphere, derived from the measured mixing ratio in the lower thermosphere. Calculations suggest that other, less abundant, trace constituents should be observable with the aid of the new, low noise electronics available at the Five College Radio Astronomy Observatory. Potentially detectable species of particular interest from the point of view of environmental pollution are odd nitrogen compounds (NO and N_2O), ClO (a chlorofluoro-methane byproduct), and possibly SO_2.

9149 Combined optical techniques for remotely determining both the size distribution and complex refractive index of atmospheric particulates. Reagan, J.A.; Byrne, D.M.; King, M.D.; Herman, B.M. (Univ. of Arizona, Tucson). pp 554-560 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A method and example results are presented for inferring both the size distribution and refractive index of atmospheric particulates from combined bistatic-mononstatic lidar and solar radiometer observations. Multi-wavelength solar radiometer measurements are first employed to obtain particulate optical depths, tau (λ), at several visible wavelengths, λ. The tau//sub p/(λ) data thus obtained are then mathematically inverted to infer a columnar particulate size distribution. Advantage is taken of the fact that the shape of the size distribution obtained by inverting the tau/sub p/(λ) data is relatively insensitive to the particle refractive index assumed for the inversion. Next, bistatic-monostatic angular scatter and backscatter lidar data are processed to extract a best fit particle refractive index subject to the constraint that the shape of the particulate size distribution be the same as that inferred from the solar radiometer tau/sub p/(λ) data. Specifically, the scattering parameters obtained from the bistatic-monostatic lidar data are compared with theoretical computations of same made for various assumed refractive index values, and the index value which yields best agreement, in a weighted least-squares sense, is selected as the optimal refractive index estimate.

9150 Aircraft instrumentation system for the remote sensing of carbon monoxide. Beck, S.M.; Hesketh, W.D.; Sherrill, R.T. (National Aeronautics and Space Administration, Hampton, VA). pp 561-565 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A light twin-engine aircraft was instrumented with a carbon monoxide remote gas sensor system and test flown over the Southern Lake Michigan basin during August 1976. The remote sensor is based on the gas filter correlation technique. The radiance levels from the sensor along with the data on the surface temperature, air temperature, dewpoint, and altitude were digitized and recorded on seven-track magnetic tape. Air samples were collected at various altitudes over selected sites for later analysis of carbon monoxide concentration and comparison with the inferred concentration from the remote sensor. The values of carbon monoxide obtained from the air samples and the values inferred from the remote sensor for data collected over water are in good agreement.

9151 Remote detection of chimney plumes by means of atmospheric electric fields. Hill, M.L.; Whyte, T.R. (Johns Hopkins Univ., Laurel, MD). pp 566-571 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A system to measure the vector of atmospheric electric fields with respect to all three axes of a maneuvering aircraft was developed and extensively flight tested. It has been found that this system can be used to detect the size and location of invisible plumes coming from chimneys, especially those equipped with electrostatic precipitators, at large distances downwind or wherever convective processes carry the plume. The information can be displayed in real time and therefore could be a valuable help in minimizing wasted effort in plume sampling experiments. The electric field effects are primarily caused by charged aerosol and pollutant particles, and it is conceivable that these measurements could be quantitatively interpreted to yield information about diffusion and convective dispersion of plumes. Some typical observations are described. The measurements to be reported were made using a twin-engined manned light aircraft. The sensor system is, however, small and light in weight and has also been extensively flown on Remotely Piloted Vehicles weighing from 10 to 80 lbs. These vehicles are briefly described, and the advantages and disadvantages of employing such unmanned probes for pollution investigations are discussed.

9152 Multispectral observation of pollutants. Norris, D.D. (Jet Propulsion Lab., Pasadena, CA). pp 572-573 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A description is given of a program that utilizes both film cameras and electronic cameras in the near-ultra-violet spectrum to provide multispectral photographic information on the spatial distribution of gases which are invisible to the eye, but that absorb light in the ultraviolet spectrum (such as ozone and SO_2). Descriptions are given of the equipment being used in the field, data processing methods to enhance visibility of low-level pollutants, and problems encountered to date in using this method. Photographic data will be presented, including ground-based measurements on power plant and smelter plumes. Plans for future investigations and opportunities for collaboration with interested organizations are discussed.

9153 Recent developments and applications with gas cell correlation spectrometer. Barringer, A.R.; Davies, J.H.; Floyd, G. (Barringer Research Ltd., Toronto, Ontario). pp 574-576 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The gas filter correlation spectrometer (GASPEL) is described. Several GASPEC units have been constructed for various spectral regions; instrument operation has centered around the 3 to 5 μm region and the 8 to 15 μm region. Target gases such as CO, CH_4, HCl, and NO, have been used. A variety of laboratory and field measurements have been undertaken. This work has been already reported. Currently a combination hydrazine/NO_2 unit is under construction. This instrument will be capable of both remote sensing and ambient measurements. It is concluded that the GASPEC con-

cept offers significant instrumental advantages over more conventional dispersive analyzers. The advantages enumerated ensure instrumental performance benefits in sensitivity, stability, dynamic range, specificity and calibration. Multi-gas versions are possible, and several dual gas versions have been constructed. Within a given spectral region where a fixed IR detector subassembly is used, flexibilty in detection of various gases can be achieved by simple change of the reference gas cell, and interference filters within the instrument. (JGB)

9154 Real-time monitoring of organic pollutants in the atmosphere using laser-induced infrared fluorescence: suggested mechanism. Robinson, J.W.; Nettles, D.; Jowett, P.L.H. (Louisiana State Univ., Baton Rouge). pp 577-578 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The relative concentrations of pollution from organic compounds in the atmosphere was monitored by measuring the intensity of fluorescence induced with a CO_2 laser. The optical system developed is optimum for monitoring ranges one to two meters in front of the laser bean but can be modified to monitor at greater distances. Interferences from infrared generated by heat can be eliminated by modulating the system. Other interferences caused by scatter from particles is the atmosphere can be eliminated by phase-shifting the detector system. The effect of quenching by nitrogen and oxygen in the ambient atmosphere was not observed. A possible explanation is presented. In addition, it was observed that fluorescence was observed at wavelengths shorter than the laser bean. A possible explanation of the mechanism of excitation is presented.

9155 Evaluation of instrument improvements to the basic COSPEC family. Barringer, A.R.; Davies, J.; Floyd, G.; Tai, M. (Barringer Research Ltd., Toronto, Ontario). pp 579-581 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

For several years the basic COSPEC (correlation spectroscopy) instrument has seen growing use and acceptance throughout the world and user feedback has led to considerations of further, basic improvements. Design changes can fall in the areas of optomechanics and electronics. Initial consideration has been given to narrowing the field of view of the instrument, while maintaining instrument etendue and sensitivity. A conceptual design review was made with respect to the use of a monochromator employing a holographic grating. The advantage of fewer reflecting surfaces results in geater optical efficiency and a simpler, cheaper optical layout. Improvements can also be achieved in the actual design of the optical correlator mask. Recent developments in microprocessing technology have led to conceptual review of their incorporation into instruments such as COSPEC, and an overivew of these possibilities is presented. Incorporation of microprocessor technology could lead to a new generator of user oriented instrumentation, as well as providing a more sophisticated and convenient data handling capability. The conceptual design of an instrument incorporating several of these design improvements is discussed.

9156 Gas filter correlation analyzer for methane. Sebacher, D.I. (National Aeronautics and Space Administration, Hampton, VA). pp 582-585 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A fast-response instrument for monitoring CH_4 was designed and tested using a modified nondispersive infrared technique. An analysis of the single-beam rotating-cell system is presented along with the signal processing circuit. A calibration of the instrument shows that the technique can be used to measure CH_4 concentrations as small as 5 ppM-m and the effects of interfering gases are analyzed.

9157 CIMATS: a correlation interferometer for the measurement of atmospheric trace species. Goldstein, H.W. (General Electric Co., Philadelphia, PA); Grenda, R.N.; Bortner, M.H.; Dick, R. pp 586-589 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A multigas correlation interferometer, based on the previously developed and tested COPE instrument, was designed and fabricated and is presently undergoing laboratory testing. The CIMATS instrument has the capability to remotely measure densities of selected gaseous atmospheric species in the spectral range 2 to 2.5 and 4 to 10 μm. The sensor was designed for both nadir viewing and earth limb viewing. As presently configured the sensor is capable of measuring ammonia, nitrous oxide, and carbon monoxide in the nonthermal infrared spectral region and carbon monoxide and sulfur dioxide in the thermal infrared. Other gaseous species can be measured by inclusion of additional narrow band filters.

9158 Real-time analysis of gaseous atmospheric pollutants to the PPT level using a mobile API mass spectrometer system. Reid, N.M. (Sciex Inc., Thornhill, Ontario); French, J.B.; Buckley, J.A.; Lane, D.A.; Lovett, A.M.; Rosenblatt, G. pp 594-600 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A description of the TAGA 2000 system and some environmental application studies are presented. This is the first commercial system designed to realize the full potential of atmospheric pressure chemical ionization coupled with mass spectrometric detection. Real time analysis of gaseous ultratrace pollutants in ambient air has been accomplished by virtue of a combination of hypersensitivity, almost instantaneous response, freedom from memory effects, and elimination of the ion clustering problems which complicated earlier API work. This combination of attributes appears to offer unprecedented productivity in analysis situations where many analysis points are required. Further, the potential of this system for real time detection of pollutants emitted by industrial and other sources, for general surveys of the presence of specific pollutants in the ambient atmosphere and for the long term monitoring of variations in trace pollutant levels in the atmosphere has been demonstrated both in the laboratory and in the field. Current, real time detection limits include: N-Nitrosodimethylamine, 1 ppT; N-Nitrosodiethylamine, 1 ppT; aniline, 1 ppT; ammonia, 0.1 ppT; toluene 2,4-diisocyanate, 100 ppB; acetone, 100 ppT; methylisobutylketone 1 ppB; dimethylmercury 1 ppB; acetonitrile 1 ppB; acrylonitrile 1 ppB; hydrogen fluoride 10 ppt; and trimethylarsine 1 ppB.

9159 Assessment and measurement techniques for open sources of emissions. Blackwood, T.R. (Monsanto Research Corp., Dayton, OH). pp 601-604 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Techniques are described which can be used to compare and assess open sources based on the magnitude and composition of the emissions. An open source is an industry which emits air pollutants in a primarily non-point manner. This includes sources of fugitive gases and dusts. These sources can have a major impact on ambient air quality owing to the persistence of the fine particle fraction and the disperse geographical locations. Also described are source-oriented sampling methods which are used to determine the emission rate while minimizing the cost of sampling activities. New techniques for sampling open sources are described. One of those developed utilizes radio controlled, real-time programming of the sampling system to selectively analyze drift of the emissions. Another system uses the latest technology in near real-time ambient air sampling of respirable and total particulate concentrations. A methodology for objective source comparison, called source severity, is described which provides a consistent basis for comparing the various emissions generated by a single source as well as for comparing the environmental impact of diverse sources.

9160 Sensing of droplet size and concentration in pollution control equipment. Magnus, D.E.; Medecki, H.; Wu, K.C. (KLD Associates, Inc., Huntington Station, NY). pp 605-609 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The measurement of entrained droplets and their concentrations in gas streams is an important requirement in pollution control technology. This type of measurement is needed to improve the performance of wet scrubbers and mist eliminators as applied in the power generation industry. Also, such measurements are needed for the assessment of entrained liquid emissions from other heavy industries. A technique for making these measurements using a heat transfer principle is presented, and the field equipment is described. Typical results from the laboratory and field studies at various facilities are presented.

9161 Morphology and elemental composition analysis by size of rocket particulate effluent. Chuan, R.L. (Brunswick Corp., Costa Mesa, CA); Woods, D.C. pp 610-613 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Particulate samples collected on six stages (with 50% cut-offs for 2 g/cm^3 mass density particles at 0.05, 0.1, 0.2, 0.4, 0.8, and 1.6 μm) of a quartz crystal microbalance cascade impactor mounted in an aircraft traversing the plume of a large solid-fueled rocket are analyzed, postflight, by scanning electron microscopy (SEM) and

energy dispersed x ray (EDXRA). The results indicate the morphology and elemental composition of the particles fall into several distinct groups. Those larger than about 0.5 μm in diameter and nearly spherical in shape contain, among elements with atomic numbers of 11 and higher, only aluminum, suggesting they are aluminum oxide formed in the solid rocket fuel combustion. Still larger but less symmetrical particles contain only sodium and chlorine. Particles much smaller than 0.5 μm seem to end up as agglomerates after impaction (or during the impaction process), and show a complex elemental make-up of Na, Al, S, Cl, K, Ca, Fe, and Zn. The un-agglomerated single particles smaller than 0.2 μm, on the other hand, show no evidence of elements above atomic number 11 at all, suggesting they may be carbon or hydrocarbon particles.

9162 Inorganic and trace element emissions from the chemically active fluid bed (CAFB) process. Werner, A.S. (GCA, Bedford, MA). pp 614-617 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Stack gas and particulate samples and solid waste samples from the Chemically Active Fluid Bed pilot plant at the Esso Research Centre, Abingdon, were collected during gasification of fuel oil and bitumen. Quantities measured included total particulate, particulate size distributions, nitrogen oxides, sulfur oxides, and gaseous organic compounds. Bulk and surface trace metal compositions of particulate and solids were determined from spark source mass spectroscopy, atomic absorption spectroscopy and x-ray photoelectron spectroscopy. Results are presented which indicate that satisfactory control of gaseous species is accomplished by this process but that additional particulate control is required.

9163 Fluorescent dye, a novel technique to trace cooling tower drift. Meyer, J.H.; Stanbro, W.D. (Johns Hopkins Univ., Laurel, MD). pp 618-623 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Drift from brackish water cooling towers has the potential to damage vegetation and crops downwind from the cooling tower. The Chalk Point Cooling Tower Project, administered by the State of Maryland Power Plant Siting Program, is conducting an extensive program to determine the extent of impact from salt drift at Potomac Electric Power Company's Chalk Point Generating Station on the Patuxent River. At Chalk Point, brackish river water is used as the circulating water in the natural draft cooling tower and as a particulate scrubbing agent for the oil fired unit's stack effluent. Since both the cooling tower and stack produce salt water drift, it is difficult to separate the contributions from the individual sources. Therefore, the cooling tower circulating water was tagged with a water soluble fluorescent dye (Rhodamine WT), so that the downwind cooling tower drift could be identified and quantified. From the preliminary deposition data analysis it appears that the fluorescent dye tracer technique provides an effective means of differentiating cooling tower drift from other drift sources.

9164 Long period time variations of ozone in the lower stratosphere. London, J. (Univ. of Colorado, Boulder). pp 677-680 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Observations of total ozone at a number of stations in the Northern Hemisphere show an increase during the period 1961 to 1970 followed by a decrease of ozone during the 1970's, at least at many stations in Central Europe. It is well known that total ozone is highly correlated with ozone in the lower stratosphere. Analysis of the trends of ozone based on data derived from balloon-borne ozonesondes during the period 1967 to 1975 at four stations in Central Europe shows that most of the ozone variations occurred in the lower stratosphere with relatively little contribution from tropospheric changes or those above the ozone peak. Possible meteorological origins of these decade type variations are discussed.

9165 Stratospheric aerosols and climatic change. Toon, O.B.; Pollack, J.B. (National Aeronautics and Space Administration, Moffett Field, CA). pp 681-682 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Stratospheric sulfuric acid particles scatter and absorb sunlight, and they scatter, absorb, and emit terrestrial thermal radiation. These interactions play a role in the Earth's radiation balance and therefore affect climate. The stratospheric aerosols are perturbed by volcanic injection of SO_2 and ash, by aircraft injection of SO_2, by rocket exhaust of Al_2O_3 and by tropospheric mixing of particles and pollutant SO_2 and COS. In order to assess the effects of these perturbations on climate, the effects of the aerosols on the radiation balance must be understood and in order to understand the radiation effects, the properties of the aerosols must be known. The aerosols' effect on the radiation balance is discussed. It is indicated that the aerosol size distribution controls whether the aerosols will tend to warm or cool the earth's surface. Calculations are presented for aerosol properties, including size distribution, for various perturbation sources using an aerosol model. Finally, calculations of the climatic impact of perturbed aerosols due to volcanic eruptions and space shuttle flights are presented.

9166 Properties of the stratospheric aerosol layer studied with a one-dimensional computer model. Turco, R.P. (R and D Associates, Marina Del Rey, CA); Toon, O.B.; Whitten, R.C.; Hamill, P.; Kiang, C.S. pp 683-688 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Aerosol particle effects are often neglected in theoretical studies of stratospheric phenomena. In reality, the particulate matter normally found above the tropopause may influence the terrestrial radiation balance, catalyze heterogeneous chemical interactions, and serve as a tracer of atmospheric motions. A one-dimensional model of the stratospheric aerosol layer was fomulated and used to compare aerosol theory with observational data. The model considers gaseous sulfur photochemistry and the physical aerosol processes of nucleation, coagulation, sedimentation, and diffusion. Calculations of the effects on the aerosol layer of stratospheric injections of aluminum oxide particles by space shuttle engines and of sulfur dioxide molecules by volcanic activity are discussed. The relation between measured aerosol variability and changes in stratospheric air temperatures and vertical transport rates is also discussed.

9167 Monitoring of atmospheric F-11 and nitric acid by means of ground-based solar spectroscopy. Bradford, C.M.; Murcray, F.H.; Murcray, D.G.; Goldman, A.; Cook, G.R. (Univ. of Denver, CO). pp 689-696 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Ground station observations have demonstrated that it is possible to routinely monitor trace atmospheric pollutants such as Fluorocarbon-11 ($CFCl_3$) using high resolution solar infrared absorption spectroscopy. Also, nitric acid, which is a photochemically significant species found largely in the stratosphere, can also be measured from ground level observations. The technique requires large zenith angles in order to obtain sufficient absorption for quantification and has the advantage that local contamination is not a significant problem. Observations over a period of time and at two different altitudes clearly indicate that F-11 is essentially tropospheric and uniformly mixed. Conversely, nitric acid is mostly stratospheric and layered. Seasonal variation in nitric acid is also observed. Typical spectra and vertical column densities of F-11 and nitric acid are presented. Spectra in other regions clearly indicate that the technique is applicable to other species.

9168 Determination of the time variations in concentrations of copper, lead, cadmium, and zinc in aerosols by square-wave voltammetry. Sturrock, P.E.; Mendez-Merced, R. (Georgia Inst. of Tech., Atlanta). pp 709-711 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

This study demonstrates the application of square-wave voltammetry to the determination of the time variations of copper, lead, cadmium, and zinc in aerosols. Due to the high sensitivity of square-wave voltammetry, especially in the anodic-stripping mode, it is possible to analyze one-hour averaged samples of particulate matter, collected with a tape sampler. Whatman 542 cellulose-fiber filters were used. The sample spots were cut out, extracted into 0.1 M HNO_3 with ultrasonic agitation, and analyzed by square-wave voltammetry from an ammonium-citrate buffer at pH 3 using a hanging mercury drop electrode. Hourly concentrations (nanograms/cubic meter) ranged from 0 to 322 for copper, 0 to 1710 for lead, 0 to 72 for cadmium, and 0 to 372 for zinc. The hourly concentration patterns were different for each of the metals and also different for weekends compared to weekdays. The lead pattern, and to some extent that of cadmium, can be correlated with automobile traffic. However, no such correlation is evident for copper or zinc, indicating other sources for these metals.

9169 Improved portable instrument for continuous monitoring of ambient particulate concentrations. Litton, C.D.; Hertzberg, M.; Graybeal, L. (Bureau of Mines, Pittsburgh, PA). pp 712-715 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The unique design of a cylindrically concentric ionization chamber whose center electrode is gold-covered americium 241 has made possible the development of a truly portable instrument for continuous monitoring of ambient particulate concentrations and for obtaining particle size distributions. The gold foil covering the americium 241 limits the primary ionization to a very small volume surrounding the center electrode. When a potential difference exists between the electrodes, the positive ions formed in the primary ionization zone drift to the outer electrode forming a unipolar charging region. Particulates entrained in the gas flow acquire charge as they pass through this region and relinquish their chage at a third, collection electrode located downstream, resulting in a current which is proportional to the particulate concentration. A second cylindrically concentric pair of electrodes, lying between the charging chamber and the collection electrode, forms the mobility analysis chamber for obtaining particle size distributions. Originally designed for the detection of spontaneous combustion in underground mines, the instrument has exhibited a much higher sensitivity than was originally anticipated. As a result, the instrument is presently undergoing a critical laboratory evaluation to determine the feasibility of using it for continuous ambient particulate monitoring.

9170 Rocket effluent size distributions made with a cascade quartz crystal microbalance. Woods, D.C. (National Aeronautics and Space Administration, Hampton, VA). pp 716-718 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Airborne particulate size distribution measurements were made in the stabilized ground cloud from a Titan III C rocket just after launch from the Kennedy Space Center on May 12, 1977. The measurements were made from aboard a small twin engine aircraft instrumented with particle and gas sensors. The plume was followed for about 1 hour while making multiple passes through the cloud at varying altitudes. The results obtained with a ten-stage cascade quartz crystal microbalance impactor show that the mass concentration as a function of particle diameter is bimodal with the first maximum between 0.05 micrometers and 0.1 micrometers and the second maximum 0.8 and 1.0 micrometer. Scanning electron microscope analysis were performed on the material collected and show distinctly different kinds of particles in the two modes.

9171 Remote sensing of environmental particulate pollutants: optical methods for determinations of size distribution and complex refractive index. Fymat, A.L. (Jet Propulsion Lab., Pasadena, CA). pp 719-723 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A unifying approach, based on a generalization of K. Pearson's differential equation of statistical theory, is proposed for both the representation of particulate size distribution and the interpretation of radiometric measurements in terms of this parameter. A single-parameter gamma-type distribution is introduced, and it is shown that inversion can only provide the dimensionless parameter rho = r/ab (r = particle radius, a = effective radius, b = effective variance), at least when the distribution vanishes at both ends. The basic inversion problem in reconstructing the particle size distribution is analyzed, and the existing methods are reviewed (with emphasis on their capabilities) and classified. A two-step strategy is proposed for simultaneously determining the complex refractive index and reconstructing the size distribution of atmospheric particulates.

9172 Atmospheric aerosol observations at Colstrip, MT. Van Valin, C.C.; Pueschel, R.F. (National Oceanic and Atmospheric Administration, Boulder, CO). pp 742-745 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Aerosol measurements with the mobile laboratory located at the Hay Coulee field site, 12 km southeast of the coal-fired powerplant at Colstrip, MT, and with the instrumented aircraft were made during measurement periods in 1975, 1976, and 1977. These observation periods correspond to the beginning and end of the growing season, with two additional field excursions with the light aircraft during February 1976 and 1977. At the Hay Coulee site light scattering was strongly dependent upon relative humidity, and a persistent diurnal cycle, with a nocturnal maximum and afternoon minimum, was measured; variations by factors of 2 to 4 were common. This was interpreted as indicating a hygroscopic aerosol population. In contrast, the Aitken nuclei (AN) concentrations were usualy highest during the afternoons and lowest at night and the early morning. Cloud condensation nuclei (CCN) and ice nuclei (IN) did not show a systematic variation; concentrations of both were slightly higher than the levels measured at other locations. The abundance of metallic elements in the natural aerosol probably accounts for the more efficient ice nucleating property; the extra CCN activity may be related to the rather high incidence of soluble sulfates and chlorides. The smoke plume from the powerplant occasionally fumigated the Hay Coulee site. At these times, AN concentrations rose to amounts from 3×10^4 to 6×10^4 per cm^3. During at least one fumigation the IN concentration increased by at least an order of magnitude; there were no detectable changes in the CCN concentrations, or in light scattering. The modest elevation of IN concentrations could have an effect on mesoscale weather, probably in terms of altered precipitation patterns.

9173 Comparison of laser and flash lamp fluorescence NO_2 monitors. Fincher, C.L.; Tucker, A.W.; Birnbaum, M. (Aerospace Corp., Los Angeles, CA). pp 754-756 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The design and performance of a laser and a flash lamp fluorescence NO_2 monitor are compared with respect to sensitivity, size, specificity, reliability, and economy. A ppB detectability for a one minute integration time in ambient air was achieved for both units. The sensitivity of the laser prototype can be readily increased to achieve 0.1 ppB detectability. A variety of tests, including use of smog chambers, has shown that our NO_2 fluorescence monitors are free of interferences; namely, they are specific for NO_2 and have a linear response. Results obtained in monitoring ambient NO_2 levels at our location (El Segundo, California) with the prototype instruments are presented and discussed.

9174 Application of the piezoelectric crystal detector in environmental science. Hlavay, J.; Guilbault, G.G. (Univ. of New Orleans, LA). pp 775-777 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The application of the piezoelectric crystal detector for the assay of the environmental pollutants, such as NH_3, HCl, and H_2S, is described. Upon the crystal, vibrating at a frequency of 9 Hz, is placed a coating specific for the gaseous pollutant to be analyzed. Upon contact with the air containing that pollutant, a change in frequency results, the magnitude of which is proportional to its concentration.

9175 Application of a kilometer pathlength FT-IR spectrometer to analysis of trace pollutants in ambient and simulated atmospheres. Tuazon, E.C.; Winer, A.M.; Graham, R.A.; Pitts, J.N. Jr. (Univ. of California, Riverside). pp 798-802 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A Fourier transform infrared (FT-IR) spectrometer has been interfaced to a multiple reflection cell consisting of eight gold-coated mirrors with a 22.5 m base path. This cell has been routinely operated at total pathlengths in excess of 1 kilometer, and detection limits of 2 to 4 parts per billion (ppB) have been established for many species suspected or known to be present in photochemical smog, including HCHO, HCOOH, HNO_3, HONO, NH_3, N_2O_5, PAN, and other peroxyacyl nitrates. During the summer of 1976 the first spectroscopic detection of HNO_3 and HCHO in Riverside ambient air was made using this system, and time-concentration profiles were obtained for these species as well as for formic acid, ammonia, ozone, PAN, etc. During the winter of 1976 to 1977 the kilometer pathlength cell was employed as an outdoor smog chamber for the study of simulated atmospheres. Of particular interest was a photooxidation study of part per million (ppM) concentrations of amines in which the carcinogen dimethylnitramine [$(CH_3)_2NNO_2$)]was unambiguously characterized by its infrared spectrum (as well as by GC-MS analysis) during irradiation of dimethylamine-NO/sub x/ mixtures. In other experiments, the first reported infrared spectrum of gaseous diethylnitramine was obtained for irradiated diethylamine-NO/sub x/ systems. The in-situ formation of the corresponding nitrosamines was also observed in this study. Results from these simulated and ambient atmospheric studies are presented.

9176 Joint European community campaign on remote sensing of SO_2 pollution from a gas plant at Lacq (France). Guillot, P. (Commission of the European Communities, Brussels, Belgium). pp 803-806 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A joint European campaign was organized around the Lacq gas plant with eight teams, in order to: compare various remote sensors around one SO_2 source monitored by chemical detectors; evaluate the usefulness and drawbacks of these remote sensing

apparatus; and determine the needs for future research in the field of remote sensing of air pollution from the ground. The aims of this first campaign were achieved. The major conclusions from it are that the remote sensors do not give plain results if they are used separately and that for interpreting the plume dispersion, detailed measurements of the meteorological parameters of the atmosphere up to 1500 meters above ground are necessary. Techniques to measure, if possible continuously, the wind and temperature as a function of height in this atmospheric layer should be developed.

9177 Time variation of urban mass loading measured by small filters compared to high-volume samplers. Crumbly, K.H. (National Aeronautics and Space Administration, Hampton, VA); Harris, F.S. Jr. pp 807-809 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Standard methods of measuring urban pollution have centered on the use of the high-volume impactor sampling for a 24-hour period. Studies have shown that 47-mm-diameter filter samples taken for 12 2-hour periods show events and trends in particulate levels during the 24-hour day that may give insight into sources and trouble areas by clues normally lost in long collection times. Measurements made at four different locations, each in a different year's field program in the highly industrialized tidewater (Norfolk region) Viginia, compare the 24-hour high-volume and 47-mm 2-hour filter samples. Usefulness of the short time sampling is illustrated from the data.

9178 Developments toward standardization of measurements of odors and odorous air pollution. Dravnieks, A. (IIT Research Inst., Chicago, IL). pp 814-816 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

In measuring odorous pollution, sensory methods are necessary since analytical data on complex mixtures cannot yet be interpreted in terms of their sensory effect. For detectability measurements, dynamic dilution forced-choice methods have several advantages, solving the problem of judgement criteria. ASTM E-544 odor intensity referencing scale based on 1-butanol odor is a useful tool. Work that may lead to a standardization of odor character description is underway. Gas-chromatography analysis and column effluent sniffing techniques, combined with a statistical comparison of GC patterns, may help in clarifying some multiple source pollution problems, and is inherently standardizable.

9179 Contribution of refuse incineration to urban aerosols. Greenberg, R.R.; Zoller, W.H.; Gordon, G.E. (Univ. of Maryland, College Park). pp 817-820 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The suspended-particle (stack) emissions from three municipal incinerators were investigated. Fly ash from two of these incinerators was also studied. The concentrations of up to 39 elements were determined. The composition of the fly ash was found to differ significantly from that of the suspended particles from the same incinerator. Long-term studies of the fly ash and suspended particles from one municipal incinerator indicated that these materials vary only slightly with time. The materials emitted from the different incinerators were found to be quite similar. Elemental size distributions on suspended particles from two incinerators were determined. Many elements were found to be strongly associated with small particles. The contribution of refuse incineration to the elemental concentrations observed on urban aerosols was estimated by assuming that three percent of the 80 $\mu g/m^3$ total suspended particulate loading typically observed in many urban areas originates from municipal incinerators. The results of this model indicate that refuse incineration can account for major fractions of the masses of Zn, Cd, Sb, and possibly Ag, In, and Sn observed on urban aerosols.

9180 Formation of inorganic and organic S(IV) species in aerosols. Izatt, R.M. (Brigham Young Univ., Provo, UT); Eatough, D.J.; Lee, M.L.; Major, T.; Richter, B.E.; Hansen, L.D.; Meisenheimer, R.G.; Fischer, J.W. pp 821-824 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Recent epidemiological and animal toxicological studies indicate that reactions between SO_2 and metal containing aerosols result in the formation of respiratory irritants. These studies point out the importance of understanding in detail the chemical species formed by such interactions. Using a combination of thermometric, ESCA and PIXE analysis techniques, it was demonstrated that both inorganic and organic S(IV) species are stable constituents of aerosols associated with pollution sources containing SO_2 and transition metals or with pollution sources resulting from the combustion of fossil fuels. The data indicate the inorganic sulfite species are present as complexes with Fe(III), Cu(II), Zn(II), and possibly Pb(II). The concentration of these inorganic sulfite species is 10 to 30% of the sulfate concentration in primary aerosols produced by smelters. In contrast, aerosol samples collected from the plume, stack, or flue lines of coal burning facilities or collected in New York City or rural Utah produce sulfite when hydrolyzed with dilute aqueous acid. It is postulated this sulfite is produced from organic-SO_2 adducts in the sample. These organic S(IV) containing species are predominantly found in the respirable size range and are present at from 5 to 50% of the sulfate concentration.

9181 Use of microscopic and bulk analyses as a multitechnique approach to determine the sources of urban dust. Linton, R.W. (Univ. of North Carolina, Chapel Hill); Natusch, D.F.S.; Hopke, P.K.; Solomon, R.L. pp 825-828 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Samples of urban dust were characterized using bulk multielemental analysis (multivariate statistical analysis [MVA] of instrumental neutron activation analysis data [INAA]) and microscopic analysis (scanning electron microscopy-energy dispersive x-ray spectrometry [SEM/EDS]). Major factors identified using MVA were related to the primary sources of urban dust particles. An alternative approach to particle source identification involved SEM/EDS determination of individual particle morphology and chemical composition. The statistical information provided by bulk analysis (INAA-MVA) complemented the specificity of the results obtained using SEM/EDS microanalysis. The advantages of the combined use of both techniques to establish the sources of environmental particles is illustrated.

9182 Measurement of α-pinene fluxes from a loblolly pine forest. Arnts, R.R. (Environmental Protection Agency, Research Triangle Park, NC); Seila, R.L.; Kuntz, R.L.; Mowry, F.L.; Knoerr, K.R.; Dudgeon, A.C. pp 829-833 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

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In recent years air pollution regulations have focused on the need to reduce hydrocarbon emissions to reduce photochemical smog. Since its inception, the Federal Air Quality Standard for hydrocarbons of 0.24 ppMC (6 to 9 AM) has been criticized as being unattainable since it has been estimated that vegetative hydrocarbon emissions exceed anthropogenic sources. However, some investigators have thought that these estimates were based on unrealistic assumptions. Chief among these is that emissions of enclosed tree parts are representative of the undisturbed tree. A novel approach to quantifying α-pinene emissions from a pine forest without disturbing the vegetation is presented. Estimates of the flux of α-pinene emanating from a stand of loblolly pine trees were obtained by measuring the net radiation and the vertical gradients of α-pinene, temperature, and water vapor above the forest using an energy balance/Bowen ratio approach.

9183 Integrated infrared gas phase band intensities of α- and β-pinenes. Wilson, H.W. (Western Washington Univ., Bellingham). pp 834-835 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The gas phase spectra of α- and β-pinenes below 2000 cm^{-1} are in part characterized by relatively intense type C bands at 788 cm^{-1} and 88 cm^{-1}, respectively. The double bond-ring deformation mades occur in the 8 to 14 micron atmospheric window region and as such they may prove useful in monitoring terpene levels under certain long path length conditions. Integrated infrared band intensities have been determined under total pressures of 1 atmosphere at moderate resolution for both bands in short path length 6 cm cells at various temperatures and partial pressures. Values of 43.5 and 129 atm-1 cm-2 were found for the α- and β-compounds respectively.

9184 Deduction of particulate mass loadings from humidity and prevailing visibility data. Reiss, N.M.; Mangano, J.J. (Rutgers-The State Univ., New Brunswick, NJ). pp 836-839 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The use of visibility and relative humidity data as predictors of atmospheric particulate mass loading is examined. Prevailing visibility records are corrected for observer bias, precipitation events, and relative humidity effects in accordance with a method recently developed by Reiss and Eversole. The visibilities were

reduced to a standard relative humidity (40%) and correlated with concurrent high-volume sampler observations of particulate mass loading. The resulting relationship is used with independent data to give the best estimate of the particulate mass loading, given only the prevailing visibility and relative humidity. This method is used to reconstruct particulate mass loadings at Newark, NJ for the period 1948 to 1968.

9185 Procedures utilized for obtaining direct and remote atmospheric carbon monoxide measurements over the lower Lake Michigan Basin in August of 1976. Casas, J.C.; Condon, E.; Campbell, S.A. (Old Dominion Univ., Norfolk, VA). pp 840-845 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

In order to establish the applicability of a gas filter correlation radiometer, GFCR, to remote carbon monoxide measurements on a regional and worldwide basis, accurate and cost effective techniques were developed for inversion of GFCR CO data and in the development of an independent gas chromatographic technique for measuring CO. This independent method is used to verify the results and the associated inversion method obtained from the GFCR. A description of both methods (direct and remote) is presented. Data obtained by both techniques during a flight test over the lower Lake Michigan Basin in August of 1976 is also discussed.

9186 Trace element concentrations downwind of Milwaukee and Chicago. Young, J.A.; Alkezweeny, A.J. (Battelle Pacific Northwest Labs., Richland, WA). pp 846-849 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The concentrations of several trace gases and trace elements were measured downwind of Chicago and Milwaukee during August of 1976 as part of the MAP3S program. The experiments were conducted in an approximately Lagrangian frame of reference using two instrumented aircraft and surface samplers. This paper will discuss the trace element measurements. Vertical profiles of trace element concentrations indicate that vertical mixing was less vigorous over Lake Michigan than over land. Trace element concentrations decreased about 6% per hour downwind of Milwaukee. Many trace elements appeared to be present on larger particles when measured on a boat on Lake Michigan than when measured on land.

9187 Ozone formation over Lake Michigan. Stedman, D.H.; Harvey, R.B.; Eastman, J.; Fingleton, D.J.; Wallace, J. (Univ. of Michigan, Ann Arbor). pp 850-852 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Ozone and NO/sub x/ levels were measured at several stations on the shore and inland in western Michigan. During a week in which ozone levels were in violation of the current standard of 0.08 ppM. Data from the rural air and from a city station were compared. The results show that the rual ozone violation is an air mass phenomenon and that city activity reduces the ozone burden at the time of morning and evening rush hours by injection of NO. This NO reacts in the nocturnal boundary layer to generate NO_2 by NO + $O_3 \rightarrow NO_2 + O_2$. The data are used to illustrate this inverse dependence of O_3 on local NO/sub x/ as well as the long range positive correlation of ozone with distant NO/sub x/ inputs.

9188 Aerosol deposition and loading of Lake Michigan. Sievering, H.; Dave, M.; Dolske, D.; Eason, M.; Forst, J.; McCoy, P.; Sutton, N.; Walther, K. (Governors State Univ., Park Forest South, IL). pp 856-859 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Modeling studies have shown that trace metal loading of the Great Lakes by atmospheric dry deposition may be equal to or greater than surface runoff loading. Environmental agencies are increasingly concerned by model-loading conclusions, given the significant increase in planned nuclear and/or coal-fired power plants for location along Great Lakes shorelines. Model validation requires specific new data. Chief among these data needs are aerosol flux across the air-water interface as a function of size as well as chemical species and micro- and meso-meteorological effects on aerosol transport over and deposition into the lake. A coordinated program of midlake shipboard sampling, aircraft overflights, and shore meteorological measurements to obtain this data is described. Cascade Impactor/Hi-Vol samplers, a modified Active Scattering Aerosol Spectrometer (ASAS) with 60 channel size-distributed aerosol counts between 0.09 and 3.53 μm diameter, and micrometeorological instrumentation were operated on board the EPA R.V. Simons. NCAR aircraft sensors included a similar ASAS as well as meteorological instruments. These shipboard and aircraft instruments were used from April through September 1977 to acquire the desired data base for the southern end of Lake Michigan. Results of experimentally tractable bulk transfer flux calculations for size-distributed aerosols and trace metals are presented. The implications for trace metal loading of Lake Michigan are briefly discussed.

9189 Influence of tobacco smoke on indoor atmospheres. II. Volatile and tobacco specific nitrosamines in main- and sidestream smoke and their contribution to indoor pollution. Brunnemann, K.D.; Adams, J.D.; Ho, D.P.S.; Hoffman, D. (American Health Foundation, Valhalla, NY). pp 876-880 of Fourth joint conference on sensing of environmental pollutants Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Chemical-analytical data are presented to illustrate the concentrations of N-nitrosamines and other compounds in main- and sidestream smoke of cigarettes. The amount of volatile nitrosamines in the sidestream smoke exceeds that of the mainstream smoke by up to 50 times. This observation led to model studies and analyses of air in train bar cars, a local bar and other indoor atmospheres polluted by tobacco smoke. The results showed that, during a one hour period in a smoke-polluted indoor environment, one may inhale volatile nitrosamines in quantities equal to those in the mainstream smoke of 0.5 to 30 cigarettes. It is emphasized that, at present, no epidemiological data exist linking human respiratory cancers to volatile nitrosamines.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 8178, 9045, 9054, 9209, 9210, 9211, 9212, 9330

9190 (CONF-791103—48) **Imprecision of dose predictions for radionuclides released to the atmosphere: an application of the Monte Carlo-simulation-technique for iodine transported via the pasture-cow-milk pathway.** Schwarz, G.; Hoffman, F.O. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The shortcomings of using mathematical models to determine compliance with regulatory standards are discussed. Methods to determine the reliability of radiation assessment models are presented. Since field testing studies are impractical, a deficiency method, which analyzes the variability of input parameters and the impact of their variability on the predicted dose, is used. The Monte Carlo technique is one of these methods. This technique is based on statistical properties of the model output when input parameters inserted in the model are selected at random from a prescribed distribution. The one big assumption one must make is that the model is a correct formulation of reality. The Gaussian plume model for atmospheric transport of airborne effluents was used to study the pasture-cow-milk-man exposure pathway and the dose calculated from radioiodine (^{131}I) transported over this pathway. (DMC)

9191 (CONF-791136—1) **Parameter uncertainty and model predictions: a review of Monte Carlo results.** Gardner, R.H.; O'Neill, R.V. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

From Symposium on error analysis of ecological models; Vienna, Austria (20 Nov 1979).

Studies of parameter variability by Monte Carlo analysis are reviewed using repeated simulations of the model with randomly selected parameter values. At the beginning of each simulation, parameter values are chosen from specific frequency distributions. This process is continued for a number of iterations sufficient to converge on an estimate of the frequency distribution of the output variables. The purpose was to explore the general properties of error propagaton in models. Testing the implicit assumptions of analytical methods and pointing out counter-intuitive results produced by the Monte Carlo approach are additional points covered.

9192 (DOE/PNRO—0292-T1) **1978 annual environmental report. Volume 2. Radiological.** (Duquesne Light Co., Shippingport, PA (USA)). 1978. Contract EY-76-C-11-0292. 120p. Dep. NTIS, PC A06/MF A01.

The Radiological Environmental Monitoring Program conducted during 1978 in the vicinity of the Beaver Valley Power Station and the Shippingport Atomic Power Station is described. The program consists of on-site sampling of water and gaseous effluents and off-site monitoring of water, air, river sediments, food pathway samples, and radiation levels in the vicinity of the site. The

results of this monitoring during 1978 are discussed. The environmental program outlined in the Beaver Valley Power Station Technical Specifications was followed throughout 1978. There were no radioactive liquid effluents released from the Shippingport Atomic Power Station, since radioactive liquids are processed and re-cycled within the plant systems. The results of this environmental monitoring program show that Shippingport Atomic Power Station and Beaver Valley Power Station operations have not adversely affected the surrounding environment.

9193 (EML—360) **Calibration of a modified Sierra Model 235 slotted cascade impactor.** Knuth, R.H. (Department of Energy, New York (USA). Environmental Measurements Lab.). Jul 1979. 24p. Dep. NTIS, PC A02/MF A01.

For measurements of ore dust in uranium concentrating mills, a Sierra Model 235 slotted cascade impactor was calibrated at a flow rate of .21 m^3/min, using solid monodisperse particles and an impaction surface of Whatman No. 41 filter paper soaked in mineral oil. The reduction from the impactor's design flow rate of 1.13 m^3/min (40 cfm) to 0.21 m^3/min (7.5 cfm) increased the stage cut-off diameters by an average factor of 2.3, a necessary adjustment because of the anticipated large particle sizes of ore dust. The underestimation of mass median diameters, often caused by the rebound and reentrainment of solid particles from dry impaction surfaces, was virtually eliminated by using the oiled Whatman No. 41 impaction surface. Observations of satisfactory performance in the laboratory were verified by tests of the impactor in ore mills.

9194 (EML—363, pp I.109-I.124) **Updating stratospheric inventories to July 1978.** Leifer, R.; Larsen, R.; Toonkel, L. 1 Oct 1979.

In Environmental Measurements Laboratory environmental quarterly, June 1-September 1, 1979.

The stratospheric inventories of Sr-90, Zr-95, Cs-137, Ce-144 and Pu-239, 240 are reported up to July 1978. The ratios of the Cs-137 inventories to those of Sr-90 are close to the theoretical production value of 1.44. Based on Sr-90 inventories and Zr-95 inventories for 1977 it is estimated that the November 17, 1976 Chinese nuclear test injected 260 kCi of Sr-90 into the Northern Hemisphere Stratosphere.

9195 (EML—363, pp II.7-II.59) **Project Airstream: radioactivity in the lower stratosphere.** Leifer, R.; Toonkel, L.; Larsen, R. 1 Oct 1979.

In Environmental Measurements Laboratory environmental quarterly, June 1-September 1, 1979.

Project Airstream is a study of radioactivity and trace gases in the lower stratosphere employing the WB-57F aircraft as a sampling platform. Radioactivity data from the missions flown in July 1978, October 1978, and April 1979 are reported. Total γ concentrations and results of radiochemical analysis of composites are tabulated.

9196 (EML—367, pp 22-25) **Measurements of filter samples of surface air.** Feely, H.W.; Toonkel, L.E. Oct 1979.

In Environmental Measurements Laboratory regional baseline station, Chester, New Jersey.

Filter samples of surface air have been collected at the Chester site since October 1976 as part of the EML Surface Air Sampling Program. Approximately 1400 cubic meters of ambient air per day are drawn through a filter of 20 centimeter diameter. Glass fiber filters were used until 28 June 1978, and Microsorban filters have been used since that time. The filters are changed approximately twice per month. Each filter is cut in half. One half of each filter is saved for possible future measurements. A two-inch diameter circle is cut from the second half of each filter, and monthly composite samples are prepared from these circles for the analysis of trace metals by x-ray fluorescence. The remainder of the second half is incorporated into a monthly composite sample for gamma counting and spectrometric analysis. Gamma spectrometric analyses have been completed on filter samples collected at the Chester site during October 1976 to March 1979. Measurements of concentrations of beryllium-7, and the fission products, zirconium-95, cerium-144, and cesium-137 are tabulated. The glass fiber filter material has not proved readily analyzable by x-ray fluorescence, so only the samples collected since 28 June 1978 will probably be analyzed by this procedure for trace metals. In addition to the continuously-operating surface air filter smapler, two intermittently-operating air filter samplers are also in use at the Chester site.

9197 (EML—367, pp 39-73) **Radon-222 measurement at Chester.** Harley, J.H. Oct 1979.

In Environmental Measurements Laboratory regional baseline station, Chester, New Jersey.

Outdoor radon concentrations have been measured at Chester, NJ, over a second one-year period from mid-1978. The two years agree very closely both for seasonal and diurnal variations. The arithmetic mean concentration was 230 pCi/m^3 this past year as compared to 220 pCi/m^3 for the preceding year. The data confirm the previous year in that the maximum daily means occur in the summer and early fall. Inversion data are not available for the site, but it was apparent again that temperature inversions can only be involved in the day-to-day and diurnal levels while seasonal levels must be controlled by emanation rate or similar factors.

9198 (EML—367, pp 236-243) **Environmental radiation monitoring.** Miller, K.M.; de Planque, G.; Boyle, M.C.; Gulbin, J.F. Oct 1979.

In Environmental Measurements Laboratory regional baseline station, Chester, New Jersey.

The long-term study of the ambient environmental radiation field at Chester begun in 1976 was continued in order to extend the basic data set on the temporal variations in the natural component and to document any perturbations due to man's activities. Monitoring of the exposure rate was again performed during the past year with high pressure ionization chambers (HPIC) and LiF thermoluminescence dosimeters (TLD). Field spectrometry was used to identify the various natural and fallout gamma-ray emitters in the soil. This site was also used to intercompare various radiation measuring devices of other groups under field conditions. Soil moisture measurements were discontinued, since sufficient data had been collected during the previous year and the basic moisture content-exposure rate correlation established for this site.

9199 (EML—367, pp 244-247) **Environmental radon monitor.** Negro, V.C. Oct 1979.

In Environmental Measurements Laboratory regional baseline station, Chester, New Jersey.

An environmental radon monitor has been in operation at Chester, New Jersey, for over two years. This unit is based on the two-filter radon measuring method. It has an automatic drive that changes the second filter every hour and transports it to a built-in scintillation counter. Its present capacity is 43 hourly samples (approximately two days). After the last sample, the transport rewinds the filter tape and the cycle repeats. Also, at the end of each cycle, the background of the counting electronics is checked. This background normally is less than 20 counts/hr. The theoretical calibration of the radon monitor is discussed.

9200 **Radioactive pollutant determinations using gamma-ray spectroscopy.** Eldridge, J.S.; Oakes, T.W.; Pruitt, M.E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Am. Ind. Hyg. Assoc. J.;* **39**: 459-465(Jun 1978).

Qualitative and quantitative determination of radionuclide contamination in environmental samples is often complicated by the presence of uranium- and thorium-series radioelements as well as ^{40}K. High resolution gamma-ray spectroscopy with lithium-drifted germanium detectors provides a method for the determination of man-made radio-nuclide contaminants in many matrices with a minimum of chemical separation. Methods have been studied for increasing the efficiency of such determinations by using large samples in reentrant beakers (Marinelli beakers) and small samples inside the well of a recently developed Ge(Li) well detector. Specific examples for the determination of ^{129}I(16 My half-life) in the well detector and recent fall-out in grass samples are presented.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

9201 **Indirect sensing of the urban heat island by satellite and the measurement of substrate parameters responsible for its formation.** Carlson, T.N. (Pennsylvania State Univ., University Park); Augustine, J.A.; Boland, F.E. pp 262-265 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Satellite-derived temperature analyses are presented for a day-night sequence over Los Angeles during October 1976. Relatively warm temperatures appear over the downtown area, industrial sections, and medium rise high density suburbs; cooler temperatures are observed over the less populated suburbs and over wooded terrain. Such thermal contrast is clearly related to the surface layer heating and reflects the nature of land use and the character of the ground surface. A method is outlined whereby a numerical surface layer temperature/heat flux model may be used to obtain by inversion, quantitative estimates of the thermal inertia and moisture availability which are essentially responsible for the formation of the urban heating pattern.

REGULATIONS

REFER ALSO TO CITATION(S) 9082

9202 EPA's fuel and fuel additive registration program. Hochheiser, S.; Purvis, B.S. (Environmental Protection Agency, Research Triangle Park, NC). pp 795-797 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

EPA's Office of Fuel and Fuel Additive Registration located at the Research Triangle Park, North Carolina, is currently registering designated fuels and fuel additives pursuant to Section 211 of the Clean Air Act Amendments of 1970. EPA may, on the basis of available scientific and technical information, regulate, by control or prohibition, the introduction into commerce of any fuel or fuel additive if emissions resulting from use of a designated fuel or fuel additive endanger public health or welfare or impair to a significant degree the performance of emission control systems. The recently enacted Clean Air Act Amendments of 1977 will alter the current requirements for registration. The current registration program, the new Clean Air Act Amendments, and the status of development of protocols for testing for fuels and fuel additives are briefly discussed.

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

9203 Natural instability and baseline studies. Willard, D.E. (Indiana Univ., Bloomington). pp 74-76 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The value of baseline studies in naturally varying ecosystems is demonstrated. Data on the effects of human impact on such systems are presented. Specific study areas include the Lake Superior Shoreline, the Wisconsin River Floodplain, and a number of bogs and marshes. In these wetlands, intervention reduces the magnitude of natural oscillations and the frequency. In some cases, the average is also markedly changed. Longer pre-impact observations are necessary to predict these changes than in more static systems, but this is hampered by the lack of adequate periods for study.

RADIOMETRIC TECHNIQUES

9204 Carbon-14 dating of small samples by proportional counting. Harbottle, G.; Sayre, E.V.; Stoenner, R.W. (Brookhaven National Lab., Upton, NY). *Science;* **206**: 683-685(9 Nov 1979).

Conventional carbon-14 dating by means of gas proportional counters has been extended to samples containing as little as 10 milligrams of carbon. The accuracy of the dating procedure has been checked by dating sequoia tree-ring samples of the 1st century A.D. and B.C. and an oak tree-ring sample of the 19th century A.D.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 8119, 9052, 9060, 9062, 9064, 9067, 9079, 9081, 9107, 9139, 9142, 9146, 9210, 9212, 9230, 9338

9205 Recent development in the United Kingdom food contamination monitoring program. Hubbard, A.W.; Lindsay, D.G. (Ministry of Agriculture, Fisheries and Food, London, England). pp 206-211 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

If food contamination monitoring is to be used to determine the degree of hazard from exposure, then it can only be effective if careful attention is paid to the means of obtaining data on the food consumption habits of the population. In addition, the assessment of hazard has to be made by reference to those consumers whose life styles, or metabolic pattern, subject them to a far greater exposure or effect than that of a normal individual. The mechanism which has been adopted in the UK to generate such data with paticular reference to metallic contaminants of the diet is described.

9206 Overview of environmental data base management problems as experienced in the Ohio River Basin Energy Study. Spencer, H.T. (Univ. of Louisville, KY); Leuthart, C.A.; Lloyd, W.G.; Rebagay, T.V.; Francis, H.E. pp 320-323 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A comprehensive three year study of the combined impacts of energy conversion facilities in the Ohio River Basin is underway. The project is known as the Ohio River Basin Energy Study (ORBES) and addresses the environmental impact(s) of possible energy conversion facility types, numbers, and distributions through the year 2000. The data base upon which this study will be based is discussed, with reference to parameters of environmental quality, particularly those of water and sediment quality. An ORBES support study concerning the radionuclide and metal ion content of late summer Ohio River sediments (McAlpine Pool 1976) is discussed.

9207 Problems in the operation of waste-injection wells in southwestern Ontario, Canada. Simpson, F. (Univ. of Windsor, Ontario). pp 479-481 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The use of disposal wells as a waste-management strategy in southwestern Ontario is of considerable interest, because of the border location of the area, the high population density, the extreme shallowness of the injection wells and the toxic nature of the injected wastes. Since the initiation of waste-injection operations in 1958, a total volume in the order of 3.5 billion US gals of fluid wastes has been introduced into the subsurface space of the area. The wastes include numerous substances, foreign to the subsurface environment, and notable among them is spent caustic from refineries inthe Sarnia district. The most commonly used disposal unit has been a dominantly carbonate rock succession, occurring only 600 to 800 feet below the surface. Operating injection pressures of up to 470 psig and workover acidization pressures of up to 800 psig fractured the disposal unit and possibly the overlying strata. Subsequently, there was contamination of near-surface aquifers by both refinery wastes and upward displaced formation fluids. Because early attempts at waste injection were conducted in an ill advised manner, it is unlikely that this approach to waste management will become politically acceptable in the area.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 9192, 9200

9208 (EGG—1183-1746) Aerial radiological survey of the area surrounding the Crystal River Power Plant, Red Level, Florida. Date of survey: March 1977. Feimster, E.L. (EG and G, Inc., Mercury, NV (USA)). Jun 1979. Contract EY-76-C-08-1183. 13p. Dep. NTIS, PC A02/MF A01.

An airborne radiological survey of an 1100 km^2 area surrounding the Crystal River Power Plant was conducted 11-15 March 1977. Detected radioisotopes, and their associated gamma ray exposure rates, were consistent with that expected from the normal background emitters. Count rates observed at 150 m altitude are converted to equivalent exposure rates at 1 m above the ground, and are presented in the form of an isopleth map. Exposure rates measured with small portable instruments and soil sample analysis agreed with the airborne data. Geological data are presented in an isopleth map of rock and soil types. A brief description of the vegetation and terrain surrounding the site is also included.

9209 (EML—363) Environmental Measurements Laboratory environmental quarterly, June 1-September 1, 1979. Hardy, E.P. Jr. (Department of Energy, New York (USA). Environmental Measurements Lab.). 1 Oct 1979. 286p. Dep. NTIS, PC A13/MF A01.

Current information from the EML environmental programs is presented. The initial section consists of interpretive reports and notes dealing with lake sampling to identify coal combustion substances, interlaboratory comparison of trace metal analyses of marine sediment, worldwide deposition of ^{90}Sr, radionuclide inventories in the stratosphere, ^{90}Sr in human bone, and corrections to a paper presented in the July 1 Quarterly. Subsequent sections include tabulation of quarterly ^{90}Sr fallout, chemical constituents of wet and dry deposition, radionuclide and trace metal concentrations in surface air, radionuclide and trace gas concentrations in the upper atmosphere and ^{90}Sr concentrations in milk, diet, and tap water. A bibliography of recent publications related to environmental studies is also presented.

9210 (EML—363(App.)) Environmental Measurements Laboratory environmental quarterly. Appendix. Toonkel, L.E. (Department of Energy, New York (USA). Environmental Measurements Lab.). 1 Oct 1979. 364p. Dep. NTIS, PC A16/MF A01.

Data are presented on the following subjects: quarterly ^{90}Sr deposition at world land sites; the chemical composition of precipitation and dry atmospheric deposition; radionuclides and trace metals

in surface air; and, radiostrontium in milk and tap water. The four sections are abstracted and indexed individually for ERA/EDB. (JGB)

9211 (EML—363(App.), pp A.1-A.41) **Quarterly ^{90}Sr deposition at world land sites.** Toonkel, L.E. 1 Oct 1979.

In Environmental Measurements Laboratory environmental quarterly. Appendix.

Results of a ^{90}Sr fallout sampling program at 77 sites beginning in 1976 are presented. Of the 77 sites for which quarterly data are reported, the monthly collections at 69 sites are composited and analyzed quarterly starting with the July 1976 samples. Data reported for the first half of 1976 at these sites as well as for the whole year at New York City and through June 1977 at the Australian sites are quarterly results obtained by summing the monthly data. As of July 1877, the Australian sites have changed over to quarterly collection. The collections are made using either high-walled stainless steel pots with exposed areas of 0.076 square meters or plastic funnels with exposed areas of 0.072 square meters to which are attached ion-exchange columns. A few sites which were established as part of a precipitation chemistry network use plastic pots with an area of 0.064 square meters for collection.

9212 (EML—363(App.), pp C.1-C.191) **Radionuclides and trace metals in surface air.** Feely, H.W.; Toonkel, L.E.; Larsen, R.J. 1 Oct 1979.

In Environmental Measurements Laboratory environmental quarterly. Appendix.

Data on spatial and temporal distribution of specific natural and man-made radioisotopes, and of trace metals in surface air are reported. The present sampling network extends around the world from about 71° North to 90° South. Sampling stations are listed along with their coordinates and elevations. Gross gamma concentrations in surface air are reported at various stations, as are concentrations of ^{7}Be, ^{54}Mn, ^{55}Fe, ^{89}Sr, ^{90}Sr, ^{95}Zr, ^{109}Cd, ^{137}Cs, ^{144}Ce, ^{210}Pb, ^{238}Pu, and ^{239}Pu. Data are also presented on concentrations of the following elements in surface air determined by atomic absorption or x-ray fluorescence analysis: Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, and Pb. (JGB)

9213 **Naturally-occurring radioactive materials in the environment: a study of the Florida phosphate industry.** Mills, W.A.; Guimond, R.J.; Windham, S.T. (Environmental Protection Agency, Washington, DC). pp 864-866 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Results of previously reported studies of natural uranium and thorium in phosphate ores produced in the United States indicate that concentrations of these natural materials range from about 10 to 400 ppM and 2 to 20 ppM, respectively. In the rich marine phosphate deposits of Florida, uranium is present in concentrations in the range 100 to 500 ppM. Uranium daughters in the phosphate ores, at least through radium-226, are usually in secular equilibrium. The purpose of present studies is to assess the radiological impact of phosphate mining, processing, use, and related activities. The study includes an extensive measurement program, an assessment of the potential health impacts, and an evaluation of the effectiveness of controls in reducing the exposure. Particular attention is devoted to potential radiological problems or radon and its decay daughters. Development of appropriate standards and guides is discussed.

SOIL

REFER ALSO TO CITATION(S) 8160, 8161, 8172, 8175, 8176, 9257

9214 (SAND—79-6006) **Adsorption and cation exchange during unidirectional flow in a saturated porous medium.** Rochon, J. (B.R.G.M., Orleans, France). (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Translated from Reunion de travail sur l'utilisation des mineraux argileux pour le confinement des dechets radioactifs, September 10-12, 1979, Paris, France. 20p. Dep. NTIS, PC A02/MF A01.

Translated by Cathy Flick.

Several models are proposed to simulate transport of an ionic substance interacting with a homogeneous porous matrix. The types of interaction studied are reversible adsorption, irreversible adsorption, and cation exchange; these are the predominant phenomena in clay media. These models were devised with regard for the simplification necessary for their further use in interpretation of soil data or in predictive calculations.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 9269, 9330

9215 (COO—3011-11) **Radioactive foodchains in the subarctic environment. Final report.** Miettinen, J.K. (Helsinki Univ. (Finland). Dept. of Radiochemistry). Sep 1979. Contract EY-76-C-02-3011. 31p. Dep. NTIS, PC A03/MF A01.

In a period of increasing body burdens this project elucidated in great detail the radioactivity of the diet and tissues of reindeer and of reindeer herding Lapps, who consume large amounts of reindeer muscle and other tissues. The detailed and precise results made possible accurate forecasts of the change of radioactivity on all trophic levels and in the critical items of the foodchains elucidated. The accurate and reliable forecasts were made possible by a detailed knowledge of all environmental and dietary factors involved. The reliable forecasts made possible correct early decisions regarding eventual application of protective measures for reduction of the extra dose from ^{137}Cs to the population group submitted to the highest extra dose, the adult male reindeer herders. The decision made was: no protective measures were necessary or recommendable, although a few individuals' dose commitment from ^{137}Cs in the body exceeded 350 mrem/y in 1965. Any protective measure which would have cast some doubt on the safety of reindeer meat as human food from radiation point of view could have jeopardized its markets. Since the Lapps' only income was reindeer meat their loss of income would have caused them much greater health hazards than the temporary extra radiation dose which would only grow to 1 rem/30 years. This project also elucidated the relatively high natural radiation dose Lapps have always received from ^{210}Po (e.g. in genitals 2500 mrem/30 y). This nuclide is cumulated in lichen from natural fallout and becomes just like ^{137}Cs enriched into reindeer (particularly its liver) and Lapps. ^{210}Po approximately doubles the natural background dose of Lapps in comparison to non-reindeer consumers.

9216 (DOE/EV/00641—33) **Cesium-134 and strontium-85 turnover rates in the centipede Scolopocryptops nigridia McNeill.** Yates, L.R.; Crossley, D.A. Jr. (Georgia Univ., Athens (USA). Dept. of Entomology). Jul 1979. Contract EY-76-C-09-0001. 23p. Dep. NTIS, PC A02/MF A01.

Radioactive tracers are providing significant information about the ecology of food chains, including such phenomena as accumulation of radioactive fission products, movement of materials along food chains, assimilation and ingestion rates, and nutrient accumulation and turnover. In this study the ingestion, assimilation and turnover to two radioactive tracers were investigated for Scolopocryptops nigridia, an abundant species in forests of the southeastern United States. The two tracers utilized, cesium-134 and strontium-85, are metabolic analogs of potassium and calcium, respectively. The research was performed as part of a larger investigation on the population ecology of the centipede species, emphasizing its relations to nutrient cycling and energy flow in a forest floor system.

9217 (EML—363(App.), pp D.1-D.7) **Radiostrontium in milk and tap water.** 1 Oct 1979.

In Environmental Measurements Laboratory environmental quarterly. Appendix.

The New York City sample is a monthly composite of pasteurized milk purchased daily at retail stores. During appropriate periods Sr-89, as well as Sr-90, are analyzed in these milk samples. The monthly Sr-90 to calcium ratios for New York City since the inception of the sampling program in 1954 are presented. Samples of New York City tap water are taken daily so that by the end of the month, approximately 100 liters have been collected. The Sr-90 data since the inception of the program are tabulated. The available cesium-137 data expressed as the Cs-137 to Sr-90 ratio are also given.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 8045, 8119, 8158, 8159, 8160, 8161, 8699, 9045

9218 (EPA/600/9—78-022, pp 187-216) **Mined land reclamation.** Curtis, W.R. (Dept. of Agriculture, Berea, KY). Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

A review of research on reclamation of mined land is presented. Studies indicate that vegetation can be successfully established on most surface mine spoils if proper mining and reclamation techniques are employed. Overburden must be moved and placed so that the best material for plant growth is on the surface. A suitable seedbed is essential. Amendments, such as lime, fertilizer, and mulch, must be used to alleviate acidity, provide nutrients, and improve plant-soil-water relations. Seeding or planting must be done at the proper time of the year. Species must be compatible with the area. Species in mixtures must be compatible with each other to assure success in achieving land reclamation goals. Legislation generally determines the degree of reclamation sought, but technology is not always available to meet regulatory requirements. Sometimes legislative

action tends to create new problems through specific requirements which have not been thoroughly researched.

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 8132, 8712, 9047, 9203, 9313

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 8315, 8907, 9052, 9060, 9061, 9062, 9064, 9067, 9079, 9081, 9087, 9107, 9139, 9142, 9188, 9205, 9206, 9256

9219 (DOE/EV—1830-1) **Combustion: an oil spill mitigation tool.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract EY-76-C-06-1830. 554p. Dep. NTIS, PC A24/MF A01.

The technical feasibility of using combustion as an oil spill mitigation tool was studied. Part I of the two-part report is a practical guide oriented toward the needs of potential users, while Part II is the research or resource document from which the practical guidance was drawn. The study included theoretical evaluations of combustion of petroleum pool fires under the effects of weathering and an oil classification system related to combustion potential. The theoretical analysis of combustion is balanced by practical experience of oil burning and case history information. Decision elements are provided which can be used as a guide for technical evaluations of a particular oil spill situation. The rationale for assessing technical feasibility is given in the context of other alternatives available for response to an oil spill. A series of research and technology development concepts are included for future research. The ethics of using oil burning are discussed as issues, concerns, and tradeoffs. A detailed annotated bibliography is appended along with a capsule review of a decade of oil burning studies and other support information.

9220 (DOE/EV—70001-50) **Transport and reaction of heavy metals in Alaskan fjord-estuaries. Annual report, July 1, 1978-June 30, 1979.** Burrell, D.C. (Alaska Univ., Fairbanks (USA). Inst. of Marine Science). Jun 1979. Contract EY-76-S-06-2229-001. 124p. (RLO—2229-T1-50). Dep. NTIS, PC A06/MF A01.

Work in progress is summarized. Individual reports are presented on the following research, which has been completed: benthic flux and near bottom reactions of heavy metals in fjords; deep water exchange in Alaskan sub-arctic fjords; sediment-seawater exchanges of nitrogen and transition metals in an Alaskan fjord; deep water renewals in Resurrection Bay, Alaska; the behavior of iron, manganese, and zinc in a heavily polluted river-estuary system. Six cruise reports for 1978 to 1979 are included, as is a list of reports and publications for the period 1975 through 1979.

9221 (EML—363, pp I.31-I.85) **Intercomparison of analyses of marine sediment for 15 trace elements.** Klusek, C.S.; Heit, M. 1 Oct 1979.

In Environmental Measurements Laboratory environmental quarterly, June 1-September 1, 1979.

Sixteen laboratories analyzed three samples of near shore marine sediment for the elements Ag, Al, As, Be, Cd, Cu, Cr, Hg, Ni, Pb, Se, Sn, Tl, V, and Zn. The samples were replicates of an air dried homogenized sediment, two in the dry state and one with added distilled deionized water. Only the Cu, Cr, Ni, and Pb concentrations were reported within the expected range of values by 50% or more of the laboratories. Although several different analytical procedures were used, the accuracy and precision of the results did not appear to be dependent on the method of analysis. No systematic differences were observed between the reported concentrations of the wet and the dry samples.

9222 (PB—298494) **Emissions assessment of conventional stationary combustion systems. Volume I. Gas- and oil-fired residential heating sources. Final report, September 1976-March 1979.** Surprenant, N.F.; Hall, R.R.; McGregor, K.T.; Werner, A.S. (TRW Environmental Engineering Div., Redondo Beach, CA (USA)). May 1979. Contract EPA-68-02-2197. 177p. NTIS PC A09/MF A01.

Emissions from gas- and oil-fired residential heating sources were assessed through a critical examination of existing emissions data, followed by the conduct of a phased measurement program to fill gaps in the emissions data base. Initially, five gas-fired and five oil-fired residential sources were selected for testing. Mass emission rates of criteria pollutants, trace elements, and organics, including polycyclic organic matter (POM), were determined. Subsequent evaluation of the test program led to a decision to conduct additional tests at one gas-fired and two oil-fired sites. The principal objective of this second test program was to determine the effect of burner on/off cycle on emissions. Particulate sulfate, SO2, and SO3 emission data were also obtained at the oil-fired sites. The results of the emissions assessment indicate that residential sources are of potential significance based on multiple source severity factors calculated for an array of houses burning gas or oil. Pollutants for which multiple source severity factors exceed 0.05, the level which may be potentially significant, are NOx from gas-fired sources and SO3, NOx, and Ni from oil-fired sources.

9223 **Identification, indexing and exchange of data on environmental pollutants.** Thompson, G.L. (Geological Survey, Reston, VA). pp 238-240 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

In August 1975 the National Water Date Exchange (NAWDEX) program was designed to facilitate water-data dissemination, to identify data sources and to improve the transfer of data from collectors to users within the water-data community. NAWDEX is a confederation of water-oriented organizations working together at all levels of the Federal, State, and local governments, and in the private and academic sectors. The benefits provided by NAWDEX to the data user include: identification of sources of water data and related data; indexing of water data and large water-data bases; data-search assistance; a nationwide network of Local Assistance Centers; improved interorganizational communication; standardization activities for the handling and transfer of water data; and referral facilities for computerized bibliographic searches. NAWDEX is designed to emphasize water-data indexing to aid in locating data vital to the solution of environmental water-pollution problems. The design concept for NAWDEX can be expanded and adapted to other environmental data to provide a comprehensive mechanism for broad environmental responses. An expanded, comprehensive design can facilitate the identification, indexing, accessibility and exchange of a wide spectrum of enviornmental data, and can provide more effective support for the sensing of environmental pollutants.

9224 **Overview of US stream quality in 1975-76: first results from the National Stream Quality Accounting Network (NASQAN).** Ficke, J.F. (Geological Survey, Reston, VA); Reisa, J.J. pp 250-253 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The National Stream Quality Accounting Network (NASQAN) was established by the US Geological Survey to provide a nationally uniform basis for continuously assessing the quality of US rivers. Stations generally are located to represent flow from the 349 water-quality accounting units (subregional drainage basins) which collectively encompass the entire land surface of the Nation. Present plans are to expand the network to 525 stations by 1979. NASQAN is a national system for uniformly summarizing or averaging the quality of rivers. NASQAN enables the evaluation of gross regional water quality patterns and their relationships to factors that cause them. NASQAN has been designated by the President's Council on Environmental Quality as the Nation's primary network for uniform water quality assessment, and has many other potential uses for providing data and analytical information to guide policy development and decisionmaking on the management of the Nation's waters. More than 2 years of data now are available from NASQAN. The data show geographic patterns of water quality that reflect climate, geology, soil types, agricultural practices, human and animal populations, water pollution, and pollution-control practices. A preliminary evaluation of data from the 1975 and 1976 water years suggests that several aspects of water quality improved significantly.

9225 **Quality assurance program of a national laboratories system.** Malo, B.A. (Geological Survey, Albany, NY); Beetem, W.A.; Friedman, L.C.; Erdmann, D.E. pp 345-347 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The needs of the United States Geological Survey's Water Resources Division has required expanded and more diverse analytical data. The implementation of expanded analytical services has included development of an extensive quality control program. Its purpose is to report data of known accuracy and precision to the analyst and manager in a timely manner. Within the laboratories system the functional levels of quality control involve the analyst and his section head, the laboratory manager, and a system level review by a quality assurance specialist. By employing computerized

data processing, quality control data are reviewed and returned to the analyst and manager one to several days after the analysis. Reference materials of known composition are an integral part of the quality assurance program. The program also provides sample preservatives and reagents for field use, and internal check and performance samples for the laboratories. This program is continually expanding to include reference materials from all sources for use with the full range of analytical requests. Quality assurance costs are approximately 20% of the operating budget for the laboratory system. By implementation of an intensive quality assurance program in the laboratories system, the expenditure rate has remained constant but permitted rapid expansion of the program and an increase in the quality control procedures available to the analyst.

9226 Paucity of primary sensors for potable water. Barnes, S. (Divison of Water, Columbus, OH). pp 348-350 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Accurate and reliable primary sensing devices are sorely needed to automate water-treatmet plants, especially if they are to be computerized. Current federal incentives have spurred development of some effective wastewater sensors, but the state of the art in potable water sensors is far behind other control system components. In lime-softening processes, it is practically impossible to keep calcium carbonate from depositing on anything immersed in the unstabilized effluent stream. Because of a decision to use computer control, the Columbus Div. of Water has been evaluating and testing critical primary sensors. Some surprising sensing techniques have been discovered, using both direct and inferred means. Other traditional techniques have been abandoned. Some of the findings are reviewed and alternate solutions are described.

9227 Recommended methods for water data acquisition: a federal/non-federal activity to develop standard methodology. Johnson, A.I.; Knapp, G.L.; Kapinos, F.P. (Geological Survey, Reston, VA). pp 351-353 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Water data collected by Federal and non-Federal organizations must be of uniformly high quality to satisfy the increased demand for information to be used in decisionmaking about development and conservation of the Nation's water resources. To coordinate data collection activites, the US Geological Survey's Office of Water Data Coordination (OWDC) is publishing the National Handbook of Recommended Methods for Water Data Acquisition. Sponsored by OWDC, prepared by Federal working groups, and reviewed by Federal and non-Federal advisory committees, the National Handbook recommends methods for acquiring data on surface water, ground water, chemical and biological water quality, sediment, soil moisture, drainage-basin characteristics, evaporation and transpiration, snow and ice, and hydrometerology. The Coordinating Council, which consists of representatives from 18 Federal agencies, and a working group of the Advisory Committee on Water Data for Public Use, which consists of representatives of non-Federal organizations, provide policy guidance. The Coordinating Council was designated as the Federal Metric Panel for Hydrology and is responsible for recommending metric units, precision of metric measurement, and metric conversion of equipment. The National Handbook will emphasize use of the SI metric system.

9228 Hydrologic and chemical assessment of an existing sanitary landfill. Kadwell, R.J.; Cundiff, R.J.; Arko, R.W.; Wolberg, D.L. (National Biocentric, Inc., St. Paul, MN). pp 467-471 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

On-land disposal of solid waste poses numerous environmental problems in monitoing the movement of chemical pollutants from the disposal area. The evaluation of an existing landfill site is further complicated since adequate baseline geologic, hydrologic, and chemical data may be either unavailable or difficult to correlate with present and future impacts. A detailed examination was conducted on a disposal site in the glaciated terrain of east-central Minnesota. A monitoring scheme was designed to supplement and redefine the existing data on vertical and horizontal leachate movement in relation to soil characteristics, groundwater flow, and surface water hydrology. Emphasis was placed on the subsurface hydrology in relationship to the leachate attenuation, ion exchange, dilution, and dispersion effects through the soil regime. Correlation coefficients and regression analysis were used to determine variations in background chemical data to leachate movement and soil characteristics. These statistical analysis identified the significant parameters which should be monitored to determine the impact on surface and groundwater systems.

9229 Development and evaluation of a helicopter-borne water-quality monitoring system. Wallace, J.W. (National Aeronautics and Space Administration, Hampton, VA); Jordan, R.A.; Flynn, J.; Thomas, R.W. pp 493-499 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A small, helicopter-borne water-quality monitoring package is being developed using a combination of basic in-situ water quality sensors and physical sample collector technology. The package is a lightweight system which can be carried and operated by one person as a passenger in a small helicopter by one person as a passenger in a small helicopter typically available by rental at commercial airports. Real-time measurements are made by suspending the water quality monitoring package with a cable from the hovering helicopter. Designed primarily for use in rapidly assessing hazardous material spills in inland and coastal zone water bodies, the system can survey as many as 20 data stations up to 1.5 kilometers apart in 1 hour. The system provides several channels of sensor data and allows for the addition of future sensors. The system will also collect samples from selected sites with sample collection on command. An EPA Spill Response Team member can easily transport, deploy, and operate the water quality monitoring package to determine the distribution, movement, and concentration of the spilled material in the water body.

9230 Estimates of the average available concentrations of nutrients and metals in bottom sediments of the Genesee River Watershed, NY. Reddy, M.M. (New York State Dept. of Health, Albany). pp 500-506 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The composition of sediments from a large watershed was determined as a step toward establishing normal concentrations of sediment constituents, their spatial, temporal, and statistical distribution, and basin-wide sources and sinks of pollutants. The chemical analysis for 12 total, or extractable (available), components in 100 bottom sediment samples collected at 28 stations in the Genesee River watershed over the period of a year is presented. The project was initiated to monitor sediment transport from this watershed to Lake Ontario, but the approach is applicable to the evaluation of fluvial sediment characterization for all large-scale rural environmental monitoring and assessment. Results show a range of statistical frequency distributions which can be used to estimate basin-wide mean concentrations and standard deviations (SD). For example, log-normal statistical analysis appears to be useful in describing sediment, C, N, and Pb concentrations. Sediment heterogeneity, found at several Genesee River sampling sites, appears to indicate poor mixing of river sediments with waste-water inputs. Contaminated and noncontaminated sediments were both obtained at different times at the same sampling point in Wellsville, NY. In the contaminated sediments, heavy metal and nutrient concentrations were at least 1 SD above the basin means. In the apparently pristine sediments, nutrient concentrations were 1 SD below the basin means. This observation supports the use of the sediment concentrations as direct indicators of pollutant inputs to the fluvial system.

9231 Detection and identification of organics in domestic wastewater before and after ozonization. Shapiro, R.H.; Kolonko, K.J.; Binder, R.T.; Barkley, R.M.; Eiceman, G.A.; Haack, L.P.; Sievers, R.E. (Univ. of Colorado, Boulder). pp 507-510 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The volatile components in wastewater samples obtained from treatment plants in Colorado before and after treatment with ozone were examined by gas chromatogaphy-mass spectrometry. The most dramatic changes in composition are the production of aldehydes and hydrocarbons upon ozonization. Apparently the precursors of these compounds are non-volatile unsaturated components in the unozonized sample. It also appears that the aldehydes are precursors of the hydrocarbons, as evidenced in laboratory experiments. In separate laboratory experiments caffeine was treated with ozone under a variety of conditions. The products of this reaction consist mainly of rearranged imidazole and triazine derivatives. The relative yields depend markedly on whether ozonization is conducted in the presence or absence of metal ions such as Fe(III).

9232 Comparison of macroinvertebrate samplers as they apply to streams of semi-arid regions. Kinney, W.L. (Environmental Protection Agency, Las Vegas, NV); Pollard, J.E.; Hornig, C.E. pp 515-518 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Streams of the arid and semi-arid regions of the western United States are characterized by irregular flow patterns resulting in highly unstable macroinvertebrate habitats and a sparse macrobenthic fauna. The use of a standard Surber sampler in these regions is of limited utility due to the combined effects of faunal paucity and patchiness. The efficiency of two types of artificial substrate samplers (basket and multiple plate), Surber samplers, and a unit-effort-traveling-kick-method was evaluated in describing macroinvertebrate communities of the White and San Juan Rivers. Although basket samples provided the largest number of animals per sample in one sample set, the kick method consistently provided data with the best statistical reproducibility. Multiple plate and Surber samples provided highly variable results in terms of the number of animals and taxa collected. The kick technique was effective in all riffle areas including those where the bottom fauna was particularly sparse and required a prohibitive number of Surber samples or multiple plate samples to adequately describe the benthic community. Some selectivity of the various samplers for different taxa was evident. For example, the unit-effort-traveling-kick method selected for the loosely attached baetid mayflies, while Surber samplers selected more heavily fo the closely attached simuliids.

9233 DACOM: a rapid, high sensitivity airborne carbon monoxide monitor. Sachse, G.W. (National Aeronautics and Space Administration, Hampton, VA); Hill, G.F.; Wade, L.O.; Condon, E.P. pp 590-593 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A rapid, high sensitivity differential abosrption carbon monoxide monitor (DACOM) was developed to measure CO from an aircraft. The differential absorption measurement is accomplished by rapidly current tuning the wavelength of a PbSSe diode lase across a single 4.7 μm CO absorption line. As the laser wavelength sweeps periodically across the absorption line, the laser bean is amplitude modulated and is then synchonously detected. With this technique a minimum detectable differential transmission of 0.02% is obtained for a 1 second integration time. This performance is equivalent to a CO sensitivity of 5 ppB for a 10 meter absorption path. The techniques used to achieve this high sensitivity will be discussed. In the aircraft installation a 10 meter absorption path is located in the airstream along the fuselage of a C-54 aircraft. During flight tests of DACOM, a sensitivity of 20 ppB for a 1-second integration time has been achieved.

9234 Application of ion chromatography to the analysis of aqueous solutions. Long, T.S.; Reinsvold, A.L. (IBM General Systems Div., Rochester, MN). pp 624-629 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Ion chromatography is a recent development which provides for the analysis of anions and cations in solution. The species can be detected in parts per million (ppM) and fractional ppM range. A theoretical discussion of this technique is given. Comparison studies were made between ion chromatography, specific ion electrodes, and wet chemical techniques for the analysis of industrial wastewater and drinking water. The analysis included the following species: F^-, Cl^-, NO_2^-, NO_3^-, PO_4^{-3}, SO_4^{-2}. All of these were run simultaneously in 30 minutes in the low ppM range. Advantages and disadvantages of this new instrumentation is discussed in detail, along with future plans to include other anions and cations. The possibility of computerization and on-line monitoring is also considered.

9235 Use of macroreticular nonionic resins to preconcentrate trace organic acids from water. Thurman, E.M.; Aiken, G.R.; Malcolm, R.L. (Geological Survey, Denver, CO). pp 630-634 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Amberlite XAD-8 (acrylic ester polymer), an adsorbent which has received little attention, and the well-known Amberlite XAD-2 (styrene-divinyl-benzene polymer), were compared with respect to energies of adsorption, sorptive capacity, and efficiency of elution for organic acids in water. These macroreticular nonionic resins vary in structure and polarity; XAD-8 is slightly polar, whereas XAD-2 is nonpolar. The XAD-8 compared favorably with XAD-2, as it exhibited energies of adsorption which were only slightly less than XAD-2. The sorptive capacity of XAD-2 exceeded XAD-8 by a factor of two, but after normalization on the basis of surface area both have similar sorptive capacities. The capacity of both resins for organic acids can be estimated quite accurately from the aqueous solubility of the solute using a log solubility-log distribution coefficient plot. Both resins are capable of removing 20 to 80 percent of the dissolved organic carbon in natural and polluted waters. The XAD-8 eluted much more efficiently than XAD-2 both for low molecular weight organic solutes and natural organic polyelectrolytes. An additional mechanism of adsorption, involving a charge transfer complex, is proposed for XAD-2. This type of bonding which occurs between the charged aromastic solutes and the aromatic resin causes the irreversible adsorption of the solute, and does not allow high recoveries of organic acids in multiple preconcentration. Therefore, in spite of increased capacity of XAD-2 resin for organic acids, there would appear to be an advantage in using XAD-8 for the preconcentration of trace organic acids from natural waters.

9236 HPLC with electrochemical detection for the measurement of trace organometallic species in environmental water samples. MacCrehan, W.A. (National Bureau of Standards, Washington, DC); Durst, R.A.; Bellama, J.M. pp 635-636 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Recent interest in the speciation of toxic metals in the environment has created a need for analytical methods that combine selectivity and sensitivity. One approach to the measurement of oganometallic compounds is presented which combines the selectivity achieved by high performance liquid chromatography with the sensitivity of electrochemical detection. Considerations regarding the choice of instrumental parameters for the measurement of such compounds as methyl-, ethyl-, and phenylmercury, methylated tin species, and trimehylantimony are outlined. The detection limits for such compounds in this system are in the nanogram to picogram range for water samples. Finally, consideration is given to sample collection, storage, and work up prior to analysis.

9237 Application of electrochemical detection to the HPLC analysis of nonvolatile pollutants. Graffeo, A.P.; Riggin, R.M. (Battelle Columbus Labs., OH). pp 637-639 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The potential applications of liquid chromatography with electochemical detection to environmental analysis is explored. Various features such as advantages and limitations of this technique are discussed. Data are presented for an analytical method for benzidine in wastewater for which a detection limit of 10 ppT is attained.

9238 Location, identification, and mapping of sewage sludge and acid waste plumes in the Atlantic Coastal Zones. Johnson, R.W.; Ohlhorst, C.W.; Usry, J.W. (National Aeronautics and Space Administration, Hampton, VA). pp 644-647 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Results of field experiments conducted in the Atlantic Coastal Zone indicated that pollution features have unique spectral characteristics which may be used to locate, identify, and map their distribution, without concurrent sea truth. When an in-scene calibration technique is used sewage sludge and acid waste dump plume identification is independent of environmental effects, the specific remote sensor (photographic or electonic) that collects data in the visible and near infrared portion of the spectrum, and geographical location of the dumping in the Atlantic Coastal Zone. After identification, the extent of the pollution feature can be mapped based on radiance differences between the plume and the background water. In addition, radiance ratio curves (e.g., in-scene calibration) obtained in the laboratory qualitatively agree with those from field experiments. These latter results indicate the feasibility of using laboratory facilities to develop and catalog spectral signatures of pollutant materials individually and in mixtures.

9239 Laboratory upwelled spectral signature measurements of secondary treated sewage sludge for remote sensing of ocean dumping. Witte, W.G.; Ursy, J.W.; Whitlock, C.H.; Gurganus, E.A. (National Aeronautics and Space Administration, Hampton, VA). pp 648-653 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A research program to evaluate the feasibilty of remotely monitoring ocean dumping of waste products such as acid and sewage sludge is underway. One aspect of the research program involves the measurements of upwelled spectral signatures for sewage mixtures of different concentrations in an 11,600 liter tank. The laboratory arrangement is described and radiance and reflectance spectra in the visible and near-infrared range are presented for concentrations ranging from 9.7 to 180 ppM of secondary-treated sewage sludge mixed with two base water types. Results indicate that upwelled radiance varies in a near linear manner with concentration and that the sludge has a practically flat signal response between 420 and 970 nanometers (nm). Reflectance spectra were

obtained for the sewage sludge mixtures at all wavelengths and concentrations. No significant variations (peaks and valleys) were observed in the reflectance spectra for any of the concentrations. The reflectance may be considered to increase linearly with concentration at all wavelengths without introducing large errors. The spectral reflectance values appear to be influenced by the type of base water.

9240 Relation of laboratory and remotely sensed spectral signatures of ocean-dumped acid waste. Lewis, B.W. (National Aeronautics and Space Administration, Hampton, VA). pp 654-658 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Results of laboratory transmission and remotely sensed ocean upwelled spectral signatures of acid waste ocean water solutions are presented. The studies were performed to establish ocean-dumped acid waste spectral signatures and to relate them to chemical and physical interactions occurring in the dump plume. The remotely sensed field measurements and the laboratory measurements were made using the same rapid-scanning spectrometer viewing a dump plume and with actual acid waste and ocean water samples, respectively. Laboratory studies showed that the signatures were produced by soluble ferric iron being precipitated in situ as ferric hydroxide upon dilution with ocean water. Seatruth water samples were taken and analyzed for pertinent major components of the acid waste. Relationships were developed between the field and laboratory data both for spectral signatures and color changes with concentration. The relationships allow for the estimation of concentration of the indicator iron from remotely sensed spectral data and the laboratory transmission concentration data without sea-truth samples.

9241 Signature extraction of ocean pollutants by eigenvector transformation of remote spectra. Grew, G.W. (National Aeronautics and Space Administration, Hampton, VA). pp 659-666 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Spectral signatures of suspended matter in the ocean are being extracted through characteristic vector analysis of remote ocean color data collected with MOCS (Multichannel Ocean Color Sensor). Spectral signatures appear to be obtainable through analyses of linear clusters that appear on scatter diagrams associated with eigenvectors. Signatures associated with acid waste, sewage sludge, oil, and algae are presented. The application of vector analysis to two acid waste dumps overflown two years apart is examined in some detail. The relationships between eigenvectors and spectral signatures for these examples are analyzed. These cases demonstrate the value of characteristic vector analysis in remotely identifying pollutants in the ocean and in determining the consistency of their spectral signatures.

9242 Marine monitoring of natural oil slicks and man made wastes utilizing an airborne imaging Fraunhofer Line Discriminator. Watson, R.D. (Geological Survey, Flagstaff, AZ); Henry, M.E.; Theisen, A.F.; Donovan, T.J.; Hemphill, W.R. pp 667-671 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Accurate measurements of the areal extent of oil slicks from selected seeps in Santa Barbara Channel, California, were achieved using a Fraunhofer Line Discriminator (FLD) operating in an imaging mode. The distribution of the oil slick as indicated on FLD images correlates well with aerial photographs, visual observation, surface verification, and simultaneous television monitoring. The advantages of this measurement technique in pollution monitoring include high sensitivity and real-time display of luminescence grey-level maps that include up to 94 grey levels. No change in luminescence with oil film thickness occurs for the Santa Barbara measurements due to the high specific gravity of this oil. Laboratory measurements on a suite of oil samples with specific gravities varying from 0.73 to 0.96 indicates positive correlation between oil film thickness and luminescence for oils of specific gravity of less than 0.875. Measurements on additional pollutants, including lignin sulfonate, Foley, Florida; phosphate processing effluents, Lakeland, Florida; oil refinery waste, Casper, Wyoming; sewage effluents at seven locations in the Denver, Colorado area; feed lot effluent east of Denver; sludge (wet, dry and ploughed) at the Denver sewage plant; and algae blooms, Ashurst Lake, Arizona; demonstrate the feasibility of using the Fraunhofer Line Discriminator in many pollution monitoring applications. Visual inspection, color aerial photography, FLD measurement of reflectance, and bore-sighted video monitor images were used to assess the correlation of areal extent of the pollutant with the luminescence measurements.

9243 Migration of anthropogenically induced trace metals (barium and lead) in a continental shelf environment. Holmes, C.W.; Martin, E.A. (Geological Survey, Corpus Christi, TX). pp 672-676 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Variation in the rates of sediment accumulation is one of the most important factors affecting physical and chemical processes within a sedimentary basin. During the past decade, a method based on ^{210}Pb disequilibrium has been devised that enables the rates of sediment accumulation to be measured for the last 150 years (BP), the time encompassed by the industrial revolution of the North American Continent. The rates of sediment accumulation at 22 sites on the Continental Shelf and upper Continental Slope in the northwestern Gulf of Mexico were determined. The rates varied from zero to greater than 7 mm per year. In an area of rapidly accumulating sediments on the central Texas shelf, south of Matagorda Bay, trace-metal profiles indicate that an increase in barium and lead has taken place in the sediments within the recent past. The rates of sedimentation as calculated by the ^{210}Pb method reveal that this increase has occurred within the last 25 years. Further inspection of the data indicates that the leading edge of the metal-contaminated sediment is migrating across the shelf at an average rate of 2 km per year.

9244 Monitoring the effects of coal refuse disposal and reclamation on water quality in southwestern Illinois. Schubert, J.P.; Olsen, R.D.; Zellmer, S.D. (Argonne National Lab., IL). pp 724-731 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The low pH and high concentrations of acidity, dissolved metals, and sulfate in water draining from an abandoned coal refuse disposal site near Staunton, Illinois, had a profound impact on water quality in the unnamed receiving stream and Cahokia Creek during periods of high surface water runoff rates during and after rainstorms. At other times, there was no surface water discharge or the discharge rate from the site was small and was neutralized by alkaline groundwater inflow to the tributary stream; duing low flow periods, most of the transition and heavy metals formed precipitates on the tributary streambed and minimal transport of these metals to Cahokia Creek occurred. Shallow groundwater in the immediate vicinity (<400 ft distance) of the gob pile was poor quality, with generally low pH and high concentrations of acidity, dissolved metals, and sulfate. Water quality was much better at distances greater than 400 ft from the pile. Attenuation of metal ions in subsurface flow was attributed to a combination of processes: dispersion, adsorption, cation exchange, and precipitation. Water in saturated slurry material generally had a low pH and relatively high concentrations of acidity, dissolved metals, and sulfate. Percolation rates of perched slurry water into the underlying glacial till and its effect on groundwater quality has not been evaluated. However, 13 residential wells in a 1/2-mile radius were samples and showed no trace of contamination by leachate from the abandoned coal refuse disposal area.

9245 Method for estimating the regional effects of land use on river-water qualtiy, Susquehanna River Basin, Pennsylvania and New York. Lystrom, D.J.; Rinella, F.A. (Geological Survey, Portland, OR). pp 732-738 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A framework for compiling available data for assessing statistical relationships between water quality and several factors of climate, physiography, and land use is presented. Eleven water-quality characteristics were compiled for 80 subbasins of the Susquehanna River basin. Water-quality characteristics used were mean concentrations or calculated yields of suspended sediment, dissolved solids, and various chemical species of nitrogen and phosphorus. As many as 57 basin characteristics were compiled for each of the 80 subbasins from available data sources. These characteristics represent six general categories: climate, topography, geology, soils, streamflow, and land use. Multiple-linear regressions were developed relating water-quality characteristics to basin characteristics. Usable regression models were defined for 10 of the 11 water-quality properties. These models explain from 58 to 89 percent of the variation of the water-quality properties, with standard errors of estimate ranging from 17 to 75 percent. The 10 models can be used to estimate water quality at specific stream sites or to simulate the generalized effect of a specific basin characteristic, such as land use, on water quality. It was concluded that this is a useful method of assessing the relationships between water-quality and basin characteristics on a regional basis.

9246 Development of an airborne laser fluorosensor for oil and water pollution monitoring. Barringer, A.R.; Davies, J.H.; Dick, R. (Barringer Research Ltd., Toronto, Ontario). pp 778-781 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

An airbone laser fluorosensor (LF), which is to be installed in a DC-3 aircraft, was developed. The instrument utilizes a 1 MW pulsed nitrogen laser (337.1 nm, 4 nsec pulse width, 200 pps repetition rate) fluorescence in targets on the water from an altitude of 1,000, to 2,000 ft. The fluorescent return signal is detected by a range gated spectrum analyzer. Noise contribution from solar background is minimized by time gating the detector in synchronization with the backscattered radiation. This technique permits the system to be operated in full daylight. The induced fluorescence signal from each laser pulse is resolved into 16 spectral channels (each of 20 nm nominal width and spacing from 380 to 700 nm) and 2 temporal channels (broad red and blue bands). The temporal channels deduce the target fluorescence decay time by a real time deconvolution technique. A dedicated microcomputer formats the raw data for a digital tape recorder and also generates a massaged video display in real time. The major applications of the instrument include oil spill classification, water pollution monitoring, and hydrologic studies.

9247 Radiative transfer model for remote sensing of suspended sediments in water. Ghovanlou, A.H. (MITRE Corp., McLean, VA); Gupta, J.N.; Henderson, R.G.; Poole, L. pp 789-794 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The development and applications of a Monte Carlo simulation model for radiative transfer in turbid water are discussed. The developed model is designed to calculate the characteristics of the backscattered signal from an illuminated body of water as a function of the turbidity level, and the spectral properties of the suspended particulates. The objective of the modeling effort is to study the remote sensing applications in relation to the concentration and spectral properties of sediments in the envionmental waters. The optical properties of the environmental waters, necessary for model applications, have been derived from available experimental data and/or calculated from the Mie formalism. Results on several applications of the model are discussed. These applications are: effects of various inputs for the volume scattering function on backscattered radiance from natural waters, and their implications for remote sensing; and, wavelength dependence of single scattering albedo, and its implication for remote sensing. Besides the radiative transfer model applications, the results of Mie calculations, which are based on measured particulate size distributions, and reasonable inputs for the real and imaginary parts of the index of refraction are presented and discussed.

9248 Biological water quality monitoing from remote stations and NASA goes satellite. Morgan, E.L. (Tennessee Technolgical Univ., Cookeville); Eagleson, K.W.; McCollough, N.; Herrmann, R. pp 885-887 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Biological response to water quality changes are presently measured, on the most part, by expensive and time consuming sampling programs which detect changes in community structure and species composition. There is a need for rapid measurement of biological response to water quality change. One such system was designed and tested using fish breathing rates to detect stressful conditions caused by water quality fluctuations. Fish breathing responses have been used as an early warning for industrial waste spills. This automated biomonitor is designed to aid in the interpretation of subtle water quality changes leading to toxic conditions in the receiving stream. In recent developments, a biomonitor using digital logic to measure fish breathing rates was interfaced with a NASA remote data collection platform for GOES-satellite transmisson data. Similarly, a Hydrolab (Model 6D) was interfaced for simultaneous measurement of dissolved oxygen, temperature, hydrogen ion concentration, conductance and oxidation-reduction potential. Both biological and physical measurements are transmitted to a data processing center for immediate interpretation of data. This design yields the capacity for remote wilderness monitoring, watershed management, identification of regional non-point source run-off pollutants and other water quality problems.

9249 Trophic classification of Colorado lakes utilizing contact data, LANDSAT and aircraft-acquired multispectral scanner data. Boland, D.H.P. (Environmental Protection Agency, Las Vegas, NV); Blackwell, R.J. pp 888-894 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Multispectral scanner data, acquired over several Colorado lakes using LANDSAT-1 and aircraft, were used in conjunction with National Eutrophication Survey contact-sensed data to determine the feasibility of assessing lacustrine trophic levels. A trophic state index was developed using contact-sensed data for several trophic indicators (chlorophyll a, inverse of Secchi disc transparency, conductivity, total phosphorous, total organic nitrogen, algal assay yield). Relationships between the digitally processed multispectral scanner data, several trophic indicators, and the trophic index were examined using a supervised multispectral classification technique and regression techniques. Statistically significant correlations exist between spectral bands, several of the trophic indicators (chlorophyll a, Secchi disc transparency, total organic nitrogen), and the trophic state index. Color-coded photomaps were generated which depict the spectral aspects of trophic state. Multispectral scanner data acquired from satellite and aircraft platforms can be used to advantage in lake monitoring and survey programs.

9250 Use of LANDSAT imagery for Lake Nasser resource management. Smith, S.E.; Fead, E.M.; Mancy, K.H. (Univ. of Michigan, Ann Arbor). pp 895-903 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Landsat imagery, in combination with ground-truthed measurements, were used for the study of the Lake Nasser Reservoir, created by the Aswan High Dam on the River Nile in Egypt and Sudan. Morphometric determinations included shoreline length and surface area and their seasonal and annual variations based on five different measurement techniques. In addition, geographical and temporal variations of surface turbidity were determined, based on Secchi disc water transparency data correlated with microdensitometric measurements of Landsat imagery. Results were interpreted in terms of the geographical distribution and degree of sedimentation of Nile silt in the reservoir. These data are being used for the assessment of current and future holding capacity of the reservoir and the impact of siltation on lake morphology and its fish resources.

9251 Water quality automation: a romance in trouble. Beach, J.S. Jr. (N-CON Systems Co., Inc., New Rochelle, NY). pp 907-908 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Manufacturers of equipment for monitoring water quality see the problem areas in these systems as: unrealistic expectations of monitoring systems; basic suitability of equipment; coordination between purchaser, manufacturer, and installing contractor for optimum design and correct installation of equipment and, lack of ongoing maintenance, trouble shooting, and calibration of the equipment after installation. The key to successful automatic monitoring systems is careful preparation and planning, preliminary studies, and clearly defined goals for specifying, installing and maintaining equipment.

9252 Wet removal of sulfur compounds from the atmosphere. Hales, J.M. (Battelle Pacific Northwest Labs., Richland, WA). *Atmos. Environ.;* **12**: No. 1-3, 389-399(1978).

From Proceedings of the international symposium on sulfur in the atmosphere; Dubrovnik, Yugoslavia (Sep 1977).

A brief overview of the current capability to calculate sulfur scavenging rates is presented. The general wet removal process can be decomposed into several individual pathways. These include direct sulfur dioxide scavenging, direct sulfate scavenging, and combined scavenging and chemical reaction. Modeling approaches for the pathways are discussed, and pertinent research areas for improvement of our present modeling capability are recommended. At the present time the calculation of direct sulfur dioxide scavenging appears to be well in hand, although more careful network measurements of dissolved sulfur dioxide concentrations in rainwater are needed to establish the relative importance of this phenomenon on a regional scale. Direct sulfate scavenging presents a more difficult calculational problem, and much more data regarding particle-size relationships of sulfate-containing aerosols is required before an adequate understanding of this pathway can be achieved. Sulfur scavenging via the pathway of sulfur dioxide absorption followed by aqueous-phase conversion is expected to be rate limited by the chemical conversion step under most circumstances. Much additional information regarding aqueous-phase transformation chemistry is necessary before a reliable calculational basis for describing this pathway can be obtained.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 9192, 9200

9253 (COO—3563-79) **Soluble and particle-associated fallout radionuclides in Mediterranean water and sediments.** Livingston, H.D.; Casso, S.A.; Bowen, V.T.; Burke, J.C. (Woods Hole Oceanographic Institution, MA (USA)). 1978. Contract EY-76-C-02-3563. 17p. (CONF-7811149—1). Dep. NTIS, PC A02/MF A01.

From 26. Congress and Plenary Assembly of the International Commission for Scientific Exploration of the Mediterranean Sea (ICSEM); Antalya, Turkey (24 Nov 1978).

From measurements in Mediterranean seawater and sediments, fallout ^{137}Cs, ^{90}Sr, and $^{239,240}Pu$ behaved mostly as soluble nuclides tracing Mediterranean water movement, whereas ^{55}Fe and ^{241}Am behaved more as particle-associated nuclides and were relatively rapidly removed to the sediments. Patterns of nuclide distribution within sediments showed depths of penetration in the order $^{55}Fe > (^{239,240}Pu, ^{137}Cs) > ^{241}Am$ and were thought to result from biological mixing on nuclides whose arrival rates varied in the same order.

9254 (COO—3563-80) **Radioelement studies in the oceans. Progress report, January 1-December 31, 1978.** Bowen, V.T. (Woods Hole Oceanographic Institution, MA (USA)). Jan 1979. Contract EY-76-S-02-3565. 13p. Dep. NTIS, PC A02/MF A01.

A bibliographic summary of reports published, submitted, in press or presented at meetings was included. A discussion of 3 cruises taken to collect samples from water, sediment cores, and plankton tows was also included. The geographical areas covered on these cruises were: (1) downwind and down-current from the U.S. Pacific Test Site, (2) across the equator in the Central Pacific, and (3) the Mid-Pacific Gyrie region. Maps are included. Samples were analyzed for a cesium 137, and plutonium on the ship. The samples were also retained for further radionuclide analysis and taxonomy (plankton) at Woods Hole. The dredging operations and problems encounted with in-situ water filtrations and chemical preparations on the first cruise were also discussed. Nutrient analysis of seawater was performed on the second cruise. The results of testing a new recording instrument are included for the third cruise.

9255 (NUREG/CR—1030) **Sediment and radionuclide transport in rivers. Phase I: field sampling program during mean flow Cattaraugus and Buttermilk Creeks, New York.** Ecker, R.M.; Onishi, Y. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 110p. (PNL—3117). Dep. NTIS, PC A06/MF A01.

A field sampling program was conducted on Cattaraugus and Buttermilk Creeks, New York during November and December 1977 to investigate the transport of radionuclides in surface waters as part of a continuing program to provide data for application and verification of Pacific Northwest Laboratory's (PNL) sediment and radionuclide transport model, SERATRA. Suspended sediment, bed sediment, and water samples were collected during mean flow conditions over a 45 mile reach of stream channel. Radiological analysis of these samples included primarily gamma ray emitters; however, some plutonium, strontium, curium, and tritium analyses were also included. The principal gamma emitter found during the sampling program was ^{137}Cs where, in some cases, levels associated with the sand and clay size fractions of bed sediment exceeded 100 pCi/g. Elevated levels of ^{137}Cs and ^{90}Sr were found downstream of the Nuclear Fuel Services Center, an inactive plutonium reprocessing plant and low level nuclear waste disposal site. Based on radionuclide levels in upstream control stations, ^{137}Cs was the only radionuclide whose levels in the creeks downstream of the site could confidently be attributed to the site during this sampling program. This field sampling effort is the first of a three phase program to collect data during low, medium and high flow conditions.

WATER

REFER ALSO TO CITATION(S) 9217

9256 (NUREG/CR—1026) **Modified finite element transport model, FETRA, for sediment and radionuclide migration in open coastal waters.** Onishi, Y.; Arnold, E.M.; Mayer, D.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 54p. Dep. NTIS, PC A04/MF A01.

The finite element model, FETRA, simulates transport of sediment and radionuclides (and other contaminants, such as heavy metals, pesticides, and other toxic substances) in surface water bodies. The model is an unsteady, two-dimensional (longitudinal and lateral) model which consists of the following three submodels coupled to include sediment-contaminant interactions: (1) sediment transport submodel, (2) dissolved contaminant transport submodel, and (3) particulate contaminant (contaminant adsorbed by sediment) transport submodel. Under the current phase of the study, FETRA was modified to include sediment-wave interaction in order to extend the applicability of the model to coastal zones and large lakes (e.g., the Great Lakes) where wave actions can be one of the dominant mechanisms to transport sediment and toxic contaminant. FETRA was further modified to handle both linear and quadratic approximations to velocity and depth distributions in order to be compatible with various finite element hydrodynamic models (e.g., RMA II and CAFE) which supply hydrodynamic input data to FETRA. The next step is to apply FETRA to coastal zones to simulate transport of sediment and radionuclides with their interactions in order to test and verify the model under marine and large lacustrine environments.

9257 **Numerical analysis of radionuclide movement from a hypothetical nuclear waste repository.** Segol, G. (Bechtel Power Corp., San Francisco, CA); Raymond, J.R. *Trans. Am. Nucl. Soc.;* **32**: 117(Jun 1979). (CONF-790602—(Summ.)).

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 8179, 9330

9258 **Effects of microcosm size and substrate type on aquatic microcosm behavior and arsenic transport.** Giddings, J.M.; Eddlemon, G.K. (Oak Ridge National Lab., TN). *Arch. Environ. Contam. Toxicol.;* **6**: 491-505(1977).

The chemical and biological characteristics of 12 freshwater microcosms of two different sizes (7-L and 70-L) and substrate types (sand and lake mud), and the fate of an introduced test contaminant (^{74}As) were explored as part of a larger study of the feasibility of using microcosms for assessing the probable fate and effects of contaminants in natural ecosystems. An inoculum of local pond algae with attendant organisms was introduced into each microcosm. Substrate type influenced chemical and biological conditions and arsenic distribution profoundly, while size had lesser effects which were probably due to differences in surface area to volume ratio. Lake sediment contributed to significantly greater algal productivity as reflected by biomass, pH, dissolved oxygen, dissolved nutrients, and chlorophyll-a. Most of the arsenic moved into the mud of the lake sediment microcosms, but remained in the water of the sand microcosms. Bioaccumulation ratios for algae ranged from 370 for 7-L sand microcosms to 4300 for lake mud microcosms. Arsenic concentrations in snails were directly proportional to substrate arsenic concentrations. Transport of arsenic in the microcosms was in good agreement with published field data. The results of the experiment emphasized the importance of selecting components for test microcosms from the specific environments most likely to incur introduction of a particular contaminant.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 9061

9259 **Sensing and predicting thermal pollution of groundwater.** Andrews, C. (Univ. of Wisconsin, Madison). pp 162-166 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A unique groundwater and surface water monitoring program has been underway for four years documenting the impacts from the construction and operation of the Columbia Generating Station, a 500 MW coal-fired power plant located on the floodplain of the Wisconsin River near Portage, Wisconsin. This research has documented changes in the quantity, quality, and direction of groundwater flow in the vicinity of a 400 acre cooling lake and a 70 acre ashpit located on the site, and has developed quantitative tools to simulate the observed impacts and to predict impacts at other generating station sites located on or proposed for alluvial sites. Changes in the direction and quantity of groundwater flow, and in the temperature of the groundwater are changing a wetland ecosystem located near the cooling lake. A finite element model, using linear isoparametric elements, was developed to simulate the observed temperature patterns in the groundwater system in the vicinity of the generating station site. The model is inexpensive to run and can readily be adopted to predicting thermal pollution of groundwater at other sites. Forty-five percent of the water pumped into the cooling lake is lost to groundwater seepage. Temperatures in the plant rooting zone in the wetland near the lake are now out of phase with seasonal temperature patterns, and are as high as 21°C in the winter, and as low as 4°C in the summer. Only 2% of the waste heat load is dissipated by groundwater.

9260 Monitoring vegetation changes in a large impacted wetland using quantitative field data and quantitative remote sensing data. Wynn, S.L. (Univ. of Wisconsin, Madison); Kiefer, R.W. pp 178-180 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

A study of the impact of siting a two unit, 1054 megawatt coal-fired generating station in a 1620 hectare wetland is described. The goals of the remote sensing portion of this large study are to use community classification by botanic and remote sensing methods to monitor change in the wetland over time, and to consider how such classification methods can best be used together to obtain information desired in a cost-effective manner. Vegetation communities are being defined by multivariate analysis of field data, by multivariate and descriptive statistical analysis of air photo ground verification data and by human and computer based air photo analysis. Changes in community composition, size and location over time are being documented by multivariate analysis of field data and by air photo interpreted and computer based mapping. The results of this study will be a demonstration of the use of various methods of documenting change over time using community classifications, and recommendations on the best combinations of methods and equipment for data collection and analysis to answer vegetation community monitoring questions at least cost.

9261 Breeding bird distributions and vegetation structure at the Columbia Generating Station. Jaeger, M.J. (Univ. of Wisconsin, Madison). pp 181-183 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The distributions of breeding passerine birds were investigated in a southern Wisconsin wetland adjacent to the cooling lake of a coal-fired generating station. The wetland has been exposed to a greatly altered water regime (discharge rates and temperature patterns) resulting from cooling lake leakage. The altered water regime is having marked effects on vegetation composition and structure. An attempt was made to model the probable changes in breeding bird frequencies in the wetlands that result from the altered water regime and vegetation composition and structure. A simplified model of Hutchinson's n-dimensional hypervolume model is used to make the frequency change predictions. This model can be applied to other situations where an action changes physical and biotic environmental factors.

9262 Use of multispectral sensing techniques for remotely estimating surface and subsurface temperature profiles in bodies of water receiving thermal outfalls. Bailey, R.E. (Ohio State Univ., Columbus); Cochran, J.K. pp 325-329 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The problem addressed is the remote determination of the 3-dimensional temperature field produced by thermal outfalls into rivers, lakes, and streams using multispectral scanning techniques. A multispectral scanning (MSS) system, mounted in an airplane flying at 8900 ft, was used to collect spectral data in 2 wavelength bands (in the emissive infrared portion of the electromagnetic spectrum) at predawn, and in 12 wavelength bands (in the visible, near-infrared and emissive infrared portions) at noon. The flights were conducted over a 15 mile segment of the Ohio River near Louisville, Kentucky, extending from the Gallagher Power Plant to the Cane Run Power Plant. The MSS data were computer processed using the digital techniques of the LARSYS system to produce accurate and detailed temperature maps of the water surface. An accuracy of +- 0.2°C was achieved, with a spatial resolution element approximately 32 ft X 43 ft. A computer program, THRM3D5, was developed to estimate the below surface temperatures by solving the energy equation in finite difference form using the size of the scanner resolution element to set the size of the calculational cell, and by using the remotely sensed surface temperature in each of the resolution elements as a boundary condition. Furthermore, empirical expressions were used to calculate the velocity profiles in the river and in the jet associated with the thermal outfall. This allowed for the estimation of eddy diffusivities. The above techniques were tested through concurrent acquisition of scanner and ground truth data at the Louisville site on July 31 and August 1, 1974. The results show that for 244 measured below surface temperatures distributed along four transects of the river, 216 temperatures calculated with THRM3D5 were within 0.2°C and an additional 13 points were within 0.4°C. One transect was 150 ft upstream of the Gallagher Power Plant and three transects were 500 ft, 2000 ft, and 4000 ft downstream.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 8062

9263 (DP-MS--79-95) Preliminary assessment of the aquatic impacts of a proposed defense waste processing facility at the Savannah River Plant. Mackey, H.E. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 138p. Dep. NTIS, PC A07/MF A01.

A review of the literature indicates that a significant body of descriptive information exists concerning the aquatic ecology of Upper Three Runs Creek and Four Mile Creek of the Savannah River Plant south of Aiken, South Carolina. This information is adequate for preparation of an environmental document evaluating these streams. These streams will be impacted by construction and operation of a proposed Defense Waste Processing Facility for solidification of high level defense waste. Potential impacts include (1) construction runoff, erosion, and siltation, (2) effluents from a chemical and industrial waste treatment facility, and (3) radionuclide releases. In order to better evaluate potential impacts, recommend mitigation methods, and comply with NEPA requirements, additional quantitative biological information should be obtained through implementation of an aquatic baseline program.

9264 (EPA—600/7-78-197a) Water-related environmental effects in fuel conversion. Volume I. Summary. Gold, H.; Goldstein, D.J. (Water Purification Associates, Cambridge, MA (USA)). Oct 1978. 253p. NTIS.

This is the first of a two-volume report that presents the results of an examination of water-related effects that can be expected from siting conversion plants in the major US coal and oil shale bearing regions. Ninety plant-site combinations were studied: 48 in the Central and Eastern US and 42 in the Western. Synthetic fuel technologies examined include: coal gasification to convert coal to pipeline gas; coal liquefaction to convert coal to low sulfur fuel oil; coal refining to produce a de-ashed, low-sulfur solvent refined (clean) coal; and oil shale retorting to produce synthetic crude. Results presented include the range of water requirements, conditions for narrowing the range and optimizing the use of water, ranges of residual solid wastes, and cost and energy requirements for wastewater treatment. A comparison of water requirements with those of two recently published studies shows widely varying estimates and emphasizes the need for both site- and design-specific calculations. A review of various combinations of cooling requirements indicates a factor of 4 difference in water consumption across all processes studied. Where water costs < 25 cents/1000 gal., a high degree of wet cooling appears best. If > $1.50/1000 gal., a minimum of wet cooling should be considered. Between these, a more balanced mix needs to be reviewed. All water requirements of this study are based on complete water re-use; i.e., no direct water discharge to streams or rivers.

9265 (EPA—600/7-78-197b) Water-related environmental effects in fuel conversion. Volume II. Appendices. Gold, H.; Goldstein, D.J. (Water Purification Associates, Cambridge, MA (USA)). Oct 1978. 666p. NTIS.

This is the second part of a two-volume report that gives results of an examination of water-related effects that can be expected from siting conversion plants in the major US coal and oil shale bearing regions. Ninety plant-site combinations were studied: 48 in the Central and Eastern US and 42 in the Western. Synthetic fuel technologies examined include: coal gasification to convert coal to pipeline gas; coal liquefaction to convert coal to low sulfur fuel oil; coal refining to produce a de-ashed, low-sulfur solvent refined (clean) coal; and oil shale retorting to produce synthetic crude. Results presented include the range of water requirements, conditions for narrowing the range and optimizing the use of water, ranges of residual solid wastes, and cost and energy requirements for wastewater treatment. The first volume is a summary of the entire study. The second volume contains 15 appendices which details all the process, cooling, and water treatment calculations. In addition the second volume contains water supply and demand data for the Eastern, Central and Western coal regions and the water transportation cost calculations. (JGB)

REGULATIONS

9266 Setting new water quality standards: a Colorado case history. Weiner, E.R. (Univ. of Denver, CO). pp 108-111 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Setting water quality standards for the purpose of regulating discharges requires knowledge about those effects of different pollutants that are relevant to the proper uses for the water. Other factors

such as the current technology for monitoring and treating effluents and the potential socio-economic impacts on the community will influence whatever procedure is adopted for attaining the standards. The Colorado Water Quality Control Commission is currently developing a system of water use classifications and appropriate quality standards, making use of technical experts and a series of public hearings to develop the needed background information. A draft proposal has been published and now is being modified in response to public comment. Several areas of public concern were not anticipated by the writers of the first draft proposal. Details of the proposed regulations are presented, along with some of the criteria used in formulating the standards. The major issues of public concern are discussed.

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 8638, 8657, 8706

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 8091, 8633, 8637

9267 (UCAR—10046) **Women in the workplace: an industrial hygienist's perspective.** Laszcz-Davis, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Sep 1979. Contract W-7405-ENG-48. 24p. (CONF-791088--1). Dep. NTIS, PC A02/MF A01.

From National safety congress; Chicago, IL, USA (15 Oct 1979).

Although the incidence of birth defects, spontaneous abortions, and stillbirths among the human population is quite high, the cause of the vast majority of these is unknown. Hundreds of agents capable of causing reproductive failure or of inducing germinal and/or somatic mutation have been recognized, but the actual magnitude of their effect on human reproductive health has not been quantified. In the era of protectionism that has developed in the last several years, lawmakers faced with chemical and physical hazards in the workplace have pondered the problem of the exposure of women of childbearing capacity to such substances. The solution has taken the form of barring women of childbearing age from jobs that could prove hazardous to the unborn child. We are in the throes of a social revolution marked by new concepts and changing value judgments with respect to women's rights, the meaning of work, and employers' responsibilities to their workers. One result has been a profusion of laws and regulations that are often confusing and sometimes conflicting. This paper presents a historical perspective on the problem, a review of the legislation promulgated and social issues fermenting, and some thoughts and hopes for the future.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 8046, 8224, 8635, 9328

9268 (PNL-2678) **Use of benefit-cost analysis in establishing Federal radiation protection standards: a review.** Erickson, L.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 77p. Dep. NTIS, PC A05/MF A01.

This paper complements other work which has evaluated the cost impacts of radiation standards on the nuclear industry. It focuses on the approaches to valuation of the health and safety benefits of radiation standards and the actual and appropriate processes of benefit-cost comparison. A brief historical review of the rationale(s) for the levels of radiation standards prior to 1970 is given. The Nuclear Regulatory Commission (NRC) established numerical design objectives for light water reactors (LWRs). The process of establishing these numerical design criteria below the radiation protection standards set in 10 CFR 20 is reviewed. EPA's 40 CFR 190 environmental standards for the uranium fuel cycle have lower values than NRC's radiation protection standards in 10 CFR 20. The task of allocating EPA's 40 CFR 190 standards to the various portions of the fuel cycle was left to the implementing agency, NRC. So whether or not EPA's standards for the uranium fuel cycle are more stringent for LWRs than NRC's numerical design objectives depends on how EPA's standards are implemented by NRC. In setting the numerical levels in Appendix I to 10 CFR 50 and 40 CFR 190 NRC and EPA, respectively, focused on the costs of compliance with various levels of radiation control. A major portion of the paper is devoted to a review and critique of the available methods for valuing health and safety benefits. All current approaches try to estimate a constant value of life and use this to vaue the expected number of lives saved. This paper argues that it is more appropriate to seek a value of a reduction in risks to health and life that varies with the extent of these risks. Additional research to do this is recommended. (DC)

BIOMEDICAL SCIENCES, BASIC STUDIES

9269 **Vascular plants on Surtsey, 1971-1976.** Friorikssson, S. (Agricultural Research Inst., Reykjavik, Iceland). Contract EY-76-C-02-3531. pp 9-24 of Surtsey research progress report VIII. Reykjavik, Iceland; Surtsey Research Society (1978).

The vascular flora of Surtsey has been investigated ever since the first higher plant was observed growing on the island in June 1965. An account of this study has been given in previous Surtsey Research Progress Reports, which cover a six year period including 1970. The investigation during the following three years, i.e., 1971, 1972, and 1973, has been reported on in a book on the development of life on Surtsey. However, in order to keep continuity of reports of this investigation in the Surtsey Research Society's records, the description of annual variation and development of higher plant life on the island in the period 1971 to 1976 will be covered here.

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 9362

9270 **How operant conditioning can contribute to behavioral toxicology.** Laties, V.G. (Univ. of Rochester School of Medicine, NY). *Environ. Health Perspect.*; **26**: 29-35(Oct 1978).

Operant conditioning can contribute to the development of behavioral toxicology in many ways. Its techniques are useful in training animals in the various behaviors the toxicologist may wish to study. They make possible the sophisticated assessment of sensory functioning. Operant conditioners excel at using schedules of intermittent reinforcement to create the type of stable animal performance needed in studying substances that produce effects only after prolonged exposure. Schedule-controlled behavior also helps elucidate the precise behavioral mechanisms involved in toxicity. In the early assessment of toxic substances a judiciously chosen sample of schedule-controlled performances may provide the best estimate whether the integrity of complex operant behavior remains unchanged. The development of improved behavioral techniques and computer technology promises to bring down the cost of such assessment.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 8283, 9302, 9305, 9307, 9311, 9319, 9333, 9361, 9371, 9374, 9375

9271 (CONF-790858—1) **Electron transfer coupled to Mn(II) oxidation in two deep-sea Pacific Ocean isolates.** Arcuri, E.J.; Ehrlich, H.L. (Oak Ridge National Lab., TN (USA); Rensselaer Polytechnic Inst., Troy, NY (USA)). 1979. Contract W-7405-ENG-26. 12p. Dep. NTIS, PC A02/MF A01.

From 4. international symposium on environmental biogeochemistry; Canberra, Australia (27 Aug 1979).

Recent work conducted to elucidate the electron transport pathway involved in Mn(II)-oxidation by Oceanospirillum strains BIII 45 and BIII 82 was reviewed and new information concerned with the cellular organization of the Mn(II)-oxidoreductase system in these organisms was presented. The presence of both b-type and c-type cytochromes was found in both strains. Cytochromes found were predominantly assoiated with the membrane fraction. A small amount was found in the periplasmic fraction. No cytochromes were found in the intracellular fraction. Mn(II) was able to reduce the c-type cytochrome only when membranes were combined with either periplasmic or intracellular fractions. An hypothesis for the mechanism of Mn(II) oxidation (similar to FeII oxidation) is presented. In this mechanism, rusticyanin is the primary electron acceptor. The oxidized rusticyanin then reduces a c-type cytochrome in the periplasmic space. The reduced cytochrome c then reduces a membrane a-type cytochrome oxidase. This would explain the necessity of combining fractions to obtain cytochrome reduction on Mn(II) addition.

9272 (COO—4374-2) **Polycyclic aromatic hydrocarbon-protein interactions. Progress report, March 1, 1979-February 28, 1980.** Fuji-

mori, E. (Boston Biomedical Research Inst., MA (USA)). Oct 1979. Contract EE-77-S-02-4374. 5p. Dep. NTIS, PC A02/MF A01.

As bovine serum albumin (BSA) undergoes acid- or base-induced conformational changes, the binding of benzo(a)pyrene (BaP) to BSA, as well as the type II uv fluorescence (380 nm) due to pyrene-like oxidation products, increases. The presence of fatty acids also enhances the binding of BaP to BSA at neutral pH, whereas the visible fluorescence of BaP is effectively quenched by fatty acids. L-Tryptophan, which is specifically bound to BSA, enhances the BaP binding and particularly the formation of pyrene-type products. Upon removal of oxygen, the production of the type I uv fluorescence (340, 357, 378 nm) probably due to BaP radicals is diminished and hydroxy-BaP derivatives are not formed. While BaP undergoes oxygen-dependent reactions with cysteine, non-carcinogenic benzo(e)pyrene does not react with cysteine. The BaP fluorescence of young collagen (from 4 to 6 weeks old rat tail tendon) is more intense than that of old collagen (from about 2 years old rat tail tendon). With increasing temperature, the former fluorescence decreases, whereas the latter increases. The denaturation temperature of both BaP-collagen and uv (365 nm)-irradiated BaP-collagen complexes does not differ from that of collagen itself.

9273 (DOE/EV/00638—13) **Properties and regulation of biosynthesis of cottonseed storage proteins. Comprehensive progress report, December 1, 1976 to September 1, 1979.** Dure, L.S. III. (Georgia Univ., Athens (USA). Dept. of Biochemistry). 1979. Contract EY-76-S-09-0638. 28p. Dep. NTIS, PC A03/MF A01.

The regulation of gene expression in cotton seed embryogenesis was studied by attempting to define what gene products are likely to be highly regulated during this developmental progression. The flow of nitrogen into the free amino acids pools of the developing cotyledons, and into the principal nitrogen nutritional reserve of the seed, the storage proteins was measured. This was continued by following the flow of nitrogen from the storage proteins to the principal exported amino acid asparagine that occurs during the first several days of germination. In this fashion the rise and fall of certain enzymes of amino acid intermediary metabolism could be postulated, and in some cases, verified. The subsets of abundant mRNAs whose appearance and disappearance coincided with developmental events in cotyledon embryogenesis/germination with the short range goal of identifying proteins/enzyme activities were delineated as well as their mRNAs that represent specific developmental stages and the long range goal of using these representatives as probes for studying the mechanisms controlling the rise and fall of these mRNAs and their protein products.

9274 (DOE/EV/00644—20) **Study of the non-histone proteins of the nucleo-chromatin complex. Progress report, May 1978-September 1979.** Patel, G.L. (Georgia Univ., Athens (USA). Dept. of Zoology). Oct 1979. Contract EY-76-S-09-0644. 9p. Dep. NTIS, PC A02/MF A01.

A study of the helix destabilizing protein (HDP) is presented. The purification and characterization of HDP from soluble and particulate phases of normal and regenerating rat liver are described. Parameters and specificities of the nucleic acid helix destabilizing activity of this protein are discussed. Interrelationships between amino acid side-chain modifications and sub-unit dissociations with the activity of the protein are described. The development and application of a radioimmunoassay and other immunological techniques for quantitation, cellular localization, and determination of tissue and species specificity of HDP are discussed.

9275 (LBL—9795) **Studies of photosynthetic membranes using chlorophyll fluorescence lifetimes.** Brewington, G.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 189p. Dep. NTIS, PC A09/MF A01.

Thesis.

The objectives of the research are to use fluorescence kinetics at room temperature as a probe of the role of chlorophyll in excitation transfer and trapping in photosynthesis. Using a single photon counting system with spark discharge excitation, the in vivo fluorescence kinetics in samples that had been treated with DCMU/NH_2OH, ferricyanide, dithionite, background actinic illumination, and different cations in the buffer were investigated. From the studies it was concluded that: (1) fluoresence at the F_0 level does not arise from pigments that are not connected to the PS II reaction center; (2) a puddle model is inadequate to explain these data; (3) these data can be accommodated by a model in which tau_1 arises from the chlorophyll a of the chlorophyll a/b light harvesting complexes, and tau_2 arises from chlorophylls more directly affected by the PS II reaction center, such as the PS II chlorophyll a antenna; and (4) the fluorescence lifetime data for samples treated with sodium or magnesium ion are consistent with the models of spillover and α-change. The fluorescence lifetime behavior in chloroplasts as a function of the redox state of the primary acceptor of PS II was also studied. The data obtained are consistent with the assignment of tau_1 to the chlorophyll in the LH complexes and with F2 arising from the PS II chlorophyll a antenna or a small group of those antennae. The model which can best explain the data assigns both of the fluorescence quenchers to either series of parallel primary electron acceptors in PS II reaction centers. The continuous increase in tau_2 in the second half of the redox curve can be explained by a model of connected photosynthetic units. (ERB)

9276 (LBL—9836) **Kinetics and thermodynamics of double strand formation in selected deoxyoligonucleotides.** Drobnies, A.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 115p. Dep. NTIS, PC A06/MF A01.

Thesis.

The thermodynamics and relaxation kinetics for the double strand-single strand transition in three deoxyoligonucleotide double helices was investigated. ΔH°, ΔS° for double helix formation and the rate constants for helix association and dissociation were measured for dATGCAT, dA_3GCT_3, and $dA_8 + dT_8$ in an effort to compare DNA double helices with similar RNA helices. No trends in these parameters due to base sequence or helix length were observed; however, from a calculation of the free energies for helix formation, it can be seen that double strand formation is less favored for each DNA oligomer than for its analogous RNA oligomer. This agrees with earlier measurements of melting temperatures for DNA and RNA double stranded polymers. The temperature jump technique was applied to the study of the relaxation kinetics of the deoxyoligomers. The association rates are the same as for the comparable RNAs in the case of the two oligomers containing GC base pairs. The association is an order of magnitude faster for $dA_8 + dT_8$ than for $rA_8 + rU_8$. In contrast to RNA oligomers where those with GC base pairs have positive activation energies for association and those with only AU base pairs have negative activation energies, the deoxyoligomers all have small negative activation energies for helix association. This is indicative of a mechanistic change between DNA and RNA double strand formation. The formation of one GC base pair is rate-limiting in RNA oligomer association. If no GC base pairs are possible, the formation of a third AU base pair is rate-limiting. In DNA, helix propagation is favored after the formation of two adjacent base pairs. Dissociation activation energies are similar for both DNA and RNA helices. (ERB)

9277 (UR—3490-1765) **Microsomal lipid peroxidation as a mechanism of cellular damage.** Kornbrust, D.J. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-C-02-3490. 142p. Dep. NTIS, PC A07/MF A01.

Thesis.

The NADPH/iron-dependent peroxidation of lipids in rat liver microsomes was found to be dependent on the presence of free ferrous ion and maintains iron in the reduced Fe^{2+} state. Chelation of iron by EDTA inhibited peroxidation. Addition of iron, after preincubation of microsomes in the absence of iron, did not enhance the rate of peroxidation suggesting that iron acts by initiating peroxidative decomposition of membrane lipids rather than by catalyzing the breakdown of pre-formed hydroperoxides. Liposomes also underwent peroxidation in the presence of ferrous iron at a rate comparable to intact microsomes and was stimulated by ascorbate. Carbon tetrachloride initiated lipid peroxidation in the absence of free metal ions. Rates of in vitro lipid peroxidation of microsomes and homogenates were found to vary widely between different tissues and species. The effects of paraquat on lipid peroxidation was also studied. (DC)

9278 **Microheterogeneity of serum transferrin, haptoglobin and α_2HS glycoprotein examined by high resolution two-dimensional electrophoresis.** Anderson, N.L.; Anderson, N.G. (Argonne National Lab., IL). *Biochem. Biophys. Res. Commun.*; **88**: No. 1, 258-265(14 May 1979).

Most human serum proteins consistently appear as more than one spot when analyzed by high resolution two-dimensional electrophoresis. We have characterized the micro-patterns corresponding to several of the principal proteins. Three minor forms of transferrin are observed (one larger than the predominant form and probably a precursor) and each shows carbohydrate heterogeneity similar to the main form. The haptoglobin β-chain exhibits stepwise heterogeneity in both pI (sialic acid variation) and SDS molecular weight (neutral sugar structure attachment), and is shown to give rise to a smaller, likewise heterogeneous product. The two frequent alleles of α_2HS glycoprotein are shown to differ predominantly in sialic acid content rather than polypeptide charge, suggesting a sequence difference at a carbohydrate attachment site. All of the expected sources of microheterogeneity (sialic acid, proteolysis, allelism) are observed, plus an SDS molecular weight microheterogeneity probably due to variation in attachment of large neutral sugar structures.

9279 **Burro aortic collagen: composition and characteristics of interaction with platelets.** Schneider, M.D. (Comparative Animal Research Lab., Oak Ridge, TN); Huang, W.O.W.; Cross, F.H.; Lin, K.T.D. Contract EY-76-C-05-0242. *Am. J. Vet. Res.*; **40**: No. 3, 377-383(Mar 1979).

A collagenous protein(s) from the aortas of three aged burros (Equus asinus) was isolated, using an acid (83.5 mM glacial acetic

acid) extraction technique and subsequent pepsin digestion of the extracts with extensive dialysis. This protein(s) was then precipitated by adding solid NaCl (w/v, 9.45 g/100 ml) to the dialyzed aortic tissue extracts. The precipitate was collected by ultracentrifugation, concentrated by dissolving in one-fourth the original volume of acetic acid, and again extensively dialyzed. Values for amino acids in residues/1,000 indicated that the extractable aortic material(s) contained substantial amounts of proline, hydroxyproline, lysine, hydroxylysine, cysteine, and all other amino acid residues usually found in collagen. Examination by electrophoresis in sodium dodecyl sulfate polyacrylamide-gel indicated the presence of 5 major polypeptide subunits of the molecular weight range of 116,000 to 300,000. A powerful inducer of platelet aggregation was found in the acid solubilized, pepsin-digested aortic extracts. Human platelets were sensitive to the agent(s) down to 0.1 to 0.2 μg of aortic solids added to 0.45 ml of platelet-rich plasma. Platelets from goats and sheep were sensitive down to additions of 0.2 μg of solids, burro platelets to 0.5 to 1 μg, bovine platelets to 1 to 2 μg, and swine platelets to 2 to 3 μg. Thus, this powerful burro aortic collagen-containing material(s) may help to distinguish minor modifications in functional characteristics of platelets from persons or animals suffering from hemostatic or thrombotic disorders.

9280 Variations in β-aspartate kinase activity during the development of maize endosperm. Henke, R.R.; Wahnbaeck-Spencer, R. (Univ. of Tennessee, Oak Ridge). Contract EY-76-C-05-0242. *FEBS (Fed. Eur. Biochem. Soc.) Lett.;* **99**: No. 1, 113-116(Mar 1979).

Two origins for the amino acids utilized in grain development are: (1) they are delivered to the developing grain by translocation through vascular connections; (2) they are synthesized de novo within the developing grain from precursors supplied by the translocation stream. The presence of nitrogen assimilatory enzymes (glutamate dehydrogenase, glutamine synthetase and asparagine synthetase) indicates how the amide nitrogen of glutamine is made available for amino acid biosynthesis in developing maize endosperm. Also present are the enzymes of the aspartate family of amino acids (aspartate kinase, homoserine dehydrogenase, and diaminopimelate decarboxylase). This study presents evidence which relates changes in aspartate kinase activity to other physiological events throughout maize endosperm development.

9281 Bile acid sulfates. III. Synthesis of 7- and 12-monosulfates of bile acids and their conjugates using a sulfur trioxide-triethylamine complex. Tserng, K.Y.; Klein, P.D. (Argonne National Lab., IL). *Steroids;* **33**: No. 2, 167-182(Feb 1979).

The 7- and 12-monosulfates of chenodeoxycholic acid, deoxycholic acid, and cholic acid were prepared by sulfation of the protected bile acids with sulfur trioxide-triethylamine in pyridine overnight and were isolated by precipitation as the p-toluidinium salt after removing the protection group(s). The taurine conjugates were obtained by conjugating the bile acid sulfates with taurine in hot dimethylformamide (DMF) in the presence of N-ethoxycarbonyl-2-ethoxy-1,2-dihydroquinoline (EEDQ). A new procedure of preparing glycine conjugated bile acid sulfates by direct conjugation of the bile acid sulfate triethylammonium salt with ethyl glycinate in boiling chloroform in the presence of EEDQ is also described. The advantages of these procedures over other procedures are their simplicity and their higher yields (typically above 90%). The thin layer chromatographic mobilities of these sulfates are presented. The influence of side chain and hydroxyl group configurations on the properties of bile acid sulfates is briefly discussed.

9282 Interactions between pairs of DNA-specific fluorescent stains bound to mammalian cells. Langlois, R.G.; Jensen, R.H. (Univ. of California, Livermore). Contract W-7405-ENG-48. *J. Histochem. Cytochem.;* **27**: No. 1, 72-79(1979).

The interactions between DNA-specific fluorescence stains complexed with mitotic Chinese hamster cells were studied by spectrofluorometric and flow fluorometric techniques. The degree of binding interactions and of energy transfer between stains was determined from the intensities and shapes of fluorescence emission spectra of cells complexed with pair of stains. The stain pairs Hoechst 33258-chromomycin A_3, Hoechst 33258-ethidium bromide, and chromomycin A_3-ethidium bromide exhibited efficient energy transfer from the short wavelength absorber (donor) to the long wavelength absorber (acceptor), and little competitive or cooperative binding of stains. The stain pair quinacrine-ethidium bromide exhibited both energy transfer and competitive binding. None of the stain pairs showed evidence of strong electronic interactions between stains. The magnitude of energy transfer interactions was used to estimate the quantity and distribution of the stains molecules complexed to mitotic cells. The results indicate a fairly even distribution of each of these stains along the DNA of intracellular mitotic chromosomes.

9283 Dynamics of protein hydration by quasi-elastic neutron scattering. Randall, J. (Univ. of Edinburgh, England); Middendorf, H.D.; Crespi, H.L.; Taylor, A.D. *Nature (London);* **276**: 636-638(7 Dec 1978).

In this manuscript the authors have presented the first high-resolution neutron spectra showing the interaction of water molecules with a fully covalently deuterated protein. They observed a hydration-dependent maximum in the quasi-elastic broadening which, at sub-monolayer coverages, seemed to be due to the jump-like migration of water molecules closely associated with or bound to the surface of protein molecules. Although more data need to be collected to substantiate this interpretation, as well as theoretical efforts to develop the analysis of quasi-elastic neutron scattering from biopolymers, the results demonstrated clearly that details of protein hydration processes down to energy changes of the order of 10^{-3}k/sub B/T or $10^{-3}cm^{-1}$ are now within reach of neutron spectroscopic techniques. A very exciting prospect of the contrast variation method is the possibility of experiments aimed at distinguishing dynamically between the water of hydration and intramolecular fluctuations. (RJC)

9284 Third site of proton translocation in green plant photosynthetic electron transport. Velthuys, B.R. (Martin Marietta Labs., Baltimore, MD). Contract EY-76-02-3326. *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 12, 6031-6034(Dec 1978).

Prereduction of the intersystem pool in isolated spinach chloroplasts leads to the appearance of a slow phase in the field-indicating 515-nm change induced by a flash. Measurements with the pH-indicator dye cresol red show that a proton uptake is associated with this slow 515-nm change. When water is the electron donor to photosystem II, electron transfer to ferricyanide is associated with the uptake of more than one proton per electron. Tetraphenylboron upon oxidation by system II releases a proton directly into the medium; yet, flash-induced electron transport from tetraphenylboron to ferricyanide is accompanied by a net uptake of protons from the medium. The above four results demonstrate the existence of two proton translocation sites in the chain between the two photoacts; the first two observations locate the new site at the oxidizing side of the plastoquinone pool.

9285 Proteolytic inactivation of a pentafunctional enzyme conjugate: coordinate protection by the first substrate. Vitto, A.; Gaertner, F.H. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Biochem. Biophys. Res. Commun.;* **82**: No. 3, 977-981(14 Jun 1978).

The arom pentafunctional enzyme conjugate of Neurospora crassa was exposed to trypsin, chymotrypsin, or a protease preparation from Neurospora in the presence and absence of the first substrate, 3-deoxy-D-arabino-heptulosonate 7-phosphate. It was found that the first substrate coordinately protects all five activities from proteolytic inactivation, which indicates a conformational change induced by this compound. In addition, the data presented are consistent with the domain theory of conjugate structure. It is also argued that coordinate protection may be of physiological significance.

9286 Electrophoretic detection of reversible chlorpromazine . HCl binding at the human erythrocyte surface. Tenforde, T.S.; Yee, J.P.; Mel, H.C. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Biochim. Biophys. Acta;* **511**: 152-162(1978).

The binding of chlorpromazine . HCl at the human erythrocyte surface has been detected through its effect on cellular electrophoretic mobility. Incubation of erythrocytes (approx. 5 . 10^6/ml) in 23 μM chlorpromazine . HCl resulted in a reduction of negative electrophoretic mobility from -1.11 +- 0.01 to -1.00 +- 0.02 (μm . s^{-1})/(V . cm^{-1}) (pH 7.2, ionic strength 0.155). This mobility change was completely reversed when chlorpromazine . HCl was removed by centrifugal washing. Increasing the drug concentration to 70 μM did not affect the mobility change, indicating saturation of the electrophoretically detectable drug binding sites. The effect of 23 μM chlorpromazine . HCl on electrophoretic mobility was also measured in isotonic media of reduced ionic strength. The drug-induced reduction in negative surface charge density was independent of ionic strength over the range 0.155 (Debye length, 0.8 nm) to 0.00310 (Debye length, 5.7 nm). Fixation of erythrocytes with glutaraldehyde affected neither the normal electrophoretic mobility of discocytes nor the reduced electrophoretic mobility of chlorpromazine . HCl-induced stomatocytes. When these stomatocytes were first fixed with glutaraldehyde, then washed free of chlorpromazine . HCl, they retained the stomatocyte form while regaining a normal control electrophoretic mobility. Conversely, when discocytes fixed in that form were treated with chlorpromazine . HCl, they showed thesame mobility change as did fixed or unfixed stomatocytes. The drug-induced mobility change is therefore independent of the shape change, but reflects a contribution to cellular surface charge density from the membrane-bound chlorpromazine . HCl molecules. It is estimated that about 10^6 chlorpromazine . HCl molecules are bound at the electrokinetic cell surface and occupy approximately 0.4% of the total surface area.

9287 Inactivation of trypsin-like proteases by sulfonylation. Variation of positively charged group and inhibitor length. Wong,

S.C.; Green, G.D.J.; Shaw, E. (Brookhaven National Lab., Upton, NY). *J. Med. Chem.;* **21**: No. 5, 456-459(1978).

Attempts to achieve selective inactivation of serine proteases of closely related specificity (trypsin-like) by aryl sulfonylation have been extended. Nitrophenyl esters of benzenesulfonic acid and phenylmethanesulfonic acid containing various positively charged groups have been synthesized and examined as inactivators of trypsin, thrombin, plasmin, plasma kallkrein, and urokinase. Examples of selective inactivation by isothiouronium derivatives were found and attributed to differences among these enzymes in geometry and flexibility of the primary specificity sites.

9288 Proton magnetic resonance studies of 9-(β-D-xylofuranosyl)adenine 3',5'-cyclic monophosphate and 9-(β-D-arabinofuranosyl)adenine 2',5'-cyclic monophosphate. MacCoss, M. (Argonne National Lab., IL); Ezra, F.S.; Robins, M.J.; Danyluk, S.S. *Carbohydr. Res.;* **62**: 203-212(1978).

A detailed ^{1}H 220-MHz n.m.r. study of 9-(β-D-xylofuranosyl)adenine 3',5'-cyclic monophosphate (3',5'-xylo-cAMP, 1) and 9-(β-D-arabinofuranosyl)adenine 2',5'-cyclic monophosphate (2',5'-ara-cAMP, 2) in D_2O solution is described. The sugar-ring conformations in 1 and 2 are shown to be ^{3}E and ^{2}E, respectively, and the phosphate rings are in a chair form. An unusual ^{4}J/sub P,H/ coupling of 2.4 Hz is observed between H-4' and phosphorus in 1 and a vicinal J/sub P,H/ of 30.8 Hz between H-5' and phosphorus in 2. This latter coupling verifies a similar value found previously in the ara-cytidine analog of 2. A comparison of the conformational properties of cyclic nucleotides having fused phosphate and sugar rings has been made, together with an assessment of the use of the Karplus constants in such ring-systems.

9289 Interconversion of plasma lipoproteins. Nichols, A.V. (Univ. of California, Berkeley). pp 157-167 of Lipoprotein molecule. Peeters, H. (ed.). New York, NY; Plenum Publishing Corp. (1978).

Interconversion of a lipoprotein molecule to a lipoprotein molecule of different physical and chemical properties perhaps can be best considered in terms of our current understanding of lipoprotein structure. Thus, normal lipoproteins are generally described as spherical structures with a core of triglycerides and cholesteryl esters stabilized by a surface of specific apoproteins, phospholipids and cholesterol. On the surface, the phospholipids and cholesterol form a monolayer in which apoproteins exhibiting amphipathic helical regions are embedded. This overview will consider interconversions which result from significant alterations in molecular size and/or shape due to enzymatically or physicochemically-induced changes in core and/or surface domains of a lipoprotein molecule. Analytic approaches to the investigation of interconversions include: preparative and analytic ultracentrifugation, electron microscopy, gel chromatography and electrophoresis, and chemical analysis.

9290 Polycyclic hydrocarbon activation in rodent liver and fibroblasts. Selkirk, J.K.; MacLeod, M.C. (Oak Ridge National Lab., TN). pp 851-864 of Tumours of early life in man and animals. Severi, L. (ed.). Monteluce, Italy; Perugia Quadrennial International Conferences on Cancer (1978).

Separation of the metabolic products of benzo(a)pyrene has been readily accomplished by high-pressure liquid chromatography. This technique is uniquely suited to compounds labile to air and light and for resolving positional isomers of phenolic or other types of oxygenated metabolites of this carcinogen. This procedure has been utilized to separate and compare benzo(a)pyrene activation and detoxification products between rodent and human cells and hepatic microsomes. Metabolite profiles of benzo(a)pyrene exhibited the same types of derivatives, marked quantitative variation was observed. Microsomal preparation produced large amounts of non-carcinogenic phenols, while intact cell metabolism favored diol formation. These results are in agreement with re-activation of metabolic diols as substrates for further activation to a more proximate carcinogenic species of benzo(a)pyrene, and caution against extrapolating metabolic results from any single test system to other species or tissues.

9291 Unit operations of enzyme purification. Hancher, C.W. (Oak Ridge National Lab., TN). *Enzyme Eng.;* **3**: 217-223(1978).

The successful purification of an enzyme from a bacterial or tissue source usually follows a general separation flowsheet consisting of the following general processing steps: (1) starting material preparation and cell harvesting, which includes tissue removal, grinding, cellular disruption and centrifugation to produce a crude extract; (2) crude extract separation, which includes diethylaminoethyl (DEAE), or other charged support, either fractional or total product precipitation, or product separation by size, gel exclusion, or membrane sizing; (3) secondary separation of the partially purified product, which usually is a combination of the above separation steps; and (4) pre- and post-treatment of the product (e.g., salt removal, water removal, and pH adjustment) to prepare for the next separation operation, which is frequently time-consuming and results in a possibility of product loss. These aspects of enzyme purification are discussed from an enzyme engineering aspect.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 9274, 9306, 9315, 9344

9292 (LA-tr—79-36) Analysis of carbon-13 nuclear magnetic resonance of some enriched amino acids and related peptides. Bengsch, E.; Ptak, M. (Centre National de la Recherche Scientifique, 45 - Orleans-la-Source (France)). Jul 1979. Translation of STI/PUB—442, pp 197-206. 13p. Dep. NTIS, PC A02/MF A01.

In view of the importance of ^{13}C magnetic resonance in the study of the configurations and chemical properties of peptides and proteins in solution, isotopically enriched amino acids and peptides have been studied. The main characteristics of the nuclear magnetic resonance (NMR) spectra are presented. The enriched amino acids were obtained by biosynthesis and therefore were uniformly enriched (80%). Some also were labeled with ^{15}N. The following were studied in particular: L-serine, L-threonine, L-aspartic acid, L-glutamic acid, cyclo (L-thr-L-thr),cyclo (L-thr-L-his) and cyclo (D-thr-L-his)dissolved in D_2O. Fourier transform spectroscopy was used, so that good spectral resolutions were obtained within a reasonable time. However, multiple couplings and nuclear isomers lead to complex and strongly coupled spectra, which were interpreted with the help of the ITR CAL Program. The values of the enrichment rates, chemical shifts, coupling constants, and isotopic shifts are given. The isotopic shifts of the ^{13}C signal for adjacent substitution are on the average +0.25 ppM for $^{1}H \rightarrow {}^{2}H$, + 0.010 ppM for $^{12}C \rightarrow {}^{13}C$ and + 0.020 ppM for $^{14}N \rightarrow {}^{15}N$; on the other hand, there is no shift of the C' nucleus signal for the substitution $^{12}C \rightarrow {}^{13}C$. From ^{13}C - ^{13}C couplings one can derive information about the charge distribution. In the case of cyclo (L-thr-L-his), the vicinal coupling constants appear to indicate a preferential configuration in solution. On the basis of these results it will be possible to make a thorough study of natural amino acids and their derivatives. The methods developed in this work will be used in studying peptides of biological interest and selectively enriched proteins.

9293 Structure and function of initiator methionine tRNA from the mitochondria of Neurospora crassa. Heckman, J.E. (Massachusetts Inst. of Tech., Cambridge); Hecker, L.I.; Schwartzbach, S.D.; Barnett, W.E.; Baumstark, B.; RajBhandary, U.L. *Cell;* **13**: 83-95(Jan 1978).

Initiator methionine tRNA from the mitochondria of Neurospora crassa has been purified and sequenced. This mitochondrial tRNA can be aminoacylated and formylated by E. coli enzymes, and is capable of initiating protein synthesis in E. coli extracts. The nucleotide composition of the mitochondrial initiator tRNA (the first mitochondrial tRNA subjected to sequence analysis) is very rich in A + U, like that reported for total mitochondrial tRNA. In two of the unique features which differentiate procaryotic from eucaryotic cytoplasmic initiator tRNAs, the mitochondrial tRNA appears to resemble the eucaryotic initiator tRNAs. Thus unlike procaryotic initiator tRNAs in which the 5' terminal nucleotide cannot form a Watson-Crick base pair to the fifth nucleotide from 3' end, the mitochondrial tRNA can form such a base pair; and like the eucaryotic cytoplasmic initiator tRNAs, the mitochondrial initiator tRNA lacks the sequence - T psiCG(or A) in loop IV. The corresponding sequence in the mitochondrial tRNA, however, is -UGCA- and not -AU(or psi)CG- as found in all eucaryotic cytoplasmic initiator tRNAs. In spite of some similarity of the mitochondrial initiator tRNA to both eucaryotic and procaryotic initiator tRNAs, the mitochondrial initiator tRNA is basically different from both these tRNAs. Between these two classes of initiator tRNAs, however, it is more homologous in sequence to procaryotic (56 to 60%) than to eucaryotic cytoplasmic initiator tRNAs (45 to 51%).

9294 Replicon properties of chromosomal DNA fibers and the duration of DNA synthesis of sunflower root-tip meristem cells at different temperatures. Van't Hof, J.; Bjerknes, C.A.; Clinton, J.H. (Brookhaven National Lab., Upton, NY). *Chromosoma;* **66**: 161-171(1978).

Chromosomal DNA fiber autoradiography was used to examine the replicon properties of root-tip meristem cells of Helianthus annuus intact seedlings grown at temperatures from 10 to 38°C and those of root-tip cells grown in vitro at 23°. The average replicon size was approximately 22 μm and it did not change with temperature nor when the roots were grown in culture. The average fork rate was 6 μm/h at 10° and it rose gradually to 12 μm/h at 38°. The responses of replication fork movement and of the duration of S to temperature were of three types: those in which change in fork rate was primarily (more than 90%) responsible for change in the duration of S, those in which the fork rate remained constant while S increased nearly twofold, and those in which the duration of S increased even though the replication forks were moving faster. The first type of response listed was observed at temperatures from 20 to 35°, the second type listed was observed at 10 to 15°, and the third, was produced at 38°.

9295 Six complementation classes of conditionally lethal protein synthesis mutants of CHO cells selected by ^{3}H-amino acid. Adair,

G.M.; Thompson, L.H.; Lindl, P.A. (Univ. of California, Livermore). *Somatic Cell Genet.;* **4**: No. 1, 27-44(1978).

Using a tritiated amino acid suicide procedure designed specifically to select conditional protein synthesis mutants, we have isolated and characterized a large number of such mutants of Chinese hamster ovary cells. All of the mutants are genetically stable and behave as recessives in somatic cell hybrids. Most of the new mutants are phenotypically dependent on the concentration of a specific amino acid as well as on temperature. In addition to identifying many additional leucyl- and asparagyl-tRNA synthetase mutants, complementation analysis has distinguished four new genetic classes representing methionine-, glutamine-, histidine-, and arginine-dependent mutants. Biochemical characterization of representative mutants from each of these six classes has identified the primary lesions as being defective aminoacyl-tRNA synthetases. Our slection results further demonstrate the high specificity of the ^{3}H-amino acid procedure for isolating protein synthesis mutants. Reconstruction experiments performed with two representative mutants indicated a selection efficiency of approximately 10% under standard conditions.

CYTOLOGY

REFER ALSO TO CITATION(S) 9275, 9282, 9311, 9328, 9371, 9373, 9379

9296 (LA-UR—79-3268) **Modular software for flow cytometry and sorting: the LACEL system.** Salzman, G.C.; Wilkins, S.F.; Whitfill, J.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 13p. (CONF-791137—1). Dep. NTIS, PC A02/MF A01.

From Engineering Foundation conference on automated cytology; Pacific Grove, CA, USA (25 Nov 1979).

We present an overview of the software for a flexible data acquisition system for multiple flow cytometers. Together with the hardware, which is discussed in a companion paper, the LACEL (Los Alamos Cell Analysis) system provides the capability to acquire data on up to 8 parameters and control bidirectional sorting based on up to 4 parameters for each direction. The two major software modules include a user interface which accepts commands and displays frequency distributions, and a data acquisition module which communicates with the hardware, moves incoming data to mass storage and generates the frequency distributions for each data parameter.

9297 **Interactive display and analysis of data from bivariate flow cytometers.** Bennett, D.E.; Mayall, B.H. (Univ. of California, Livermore). Contract W-7405-ENG-48. *J. Histochem. Cytochem.;* **27**: No. 1, 579-583(1979).

An interactive computer program, SWELL, displays and analyzes bivariate distributions generated by flow cytometers. SWELL is modular with options available via a menu, is written in Fortran, and utilizes a video color display system. Data are accumulated as a bivariate distribution that is transferred to the computer as a 64 x 64 matrix. For ease of visualization, matrices are displayed in pseudocolor. The distribution values are broken into eight ranges and each range is represented by a color. Each element of the matrix is then displayed in its assigned color. To allow pooling and comparison, distributions are aligned, edited, and standardized. Unknown samples are pooled or analyzed singly and compared to the normal pool by subtraction. Differences are displayed as pseudocolor matrices of sign, magnitude, or statistical magnitude in units of standard deviation. This latter display, scaled to tolerance limits, readily reveals regions of significant difference between normal and abnormal samples. Counts within such regions can be compared to diagnose samples automatically.

9298 **Slit-scan flow cytometry of mammalian chromosomes.** Gray, J.W.; Peters, D.; Merrill, J.T.; Martin, R.; Van Dilla, M.A. (Univ. of California, Livermore). *J. Histochem. Cytochem.;* **27**: No. 1, 441-444(1979).

A flow cytometer has been constructed which measures total fluorescence and the distribution of fluorescence along isolated, stained mammalian chromosomes. In this device, chromosomes flow lengthwise at 4 m/sec through a 1-μm thick laser beam. The fluorescence from each chromosome is recorded at 10 nsec intervals; the sequence of recorded values represents the distribution of fluorescence along the chromosome and is stored in the memory of a waveform recorder. The total fluorescence of each chromosome is also measured and recorded. Preliminary studies show that doublets of 1.83 μm diameter microspheres flow with their long axes parallel to the direction of flow and that the two microspheres are resolved in the slit-scan profile. Ethidium bromide stained Muntjac and Chinese hamster chromosomes have also been slit-scanned. Centromeres were resolved in many of the Nos. 1 and 2 Chinese hamster chromosomes and the Nos. 1 and X + 3 Muntjac chromosomes.

9299 **Template method for decomposing flow cytometry histograms of human chromosomes.** Moore, D.H. II. (Univ. of California, Livermore). *J. Histochem. Cytochem.;* **27**: No. 1, 305-310(1979).

A new method for decomposing flow cytometry histograms of isolated human metaphase chromosomes is described and tested. The method is based on fitting a template, composed of the means of all chromosomes of a normal karyotype to the flow histogram. The utility of the method is demonstrated by application to flow measurements of chromosomes from a normal person and comparing the results with those obtained by conventional cytophotometry. The power of the method for detecting gross chromosomal abnormalities, such as trisomy 21, as well as more subtle variations such as a single translocation, is determined for simulated data.

9300 **Investigations in high-precision sorting.** Merrill, J.T.; Dean, P.N.; Gray, J.W. (Univ. of California, Livermore). Contract W-7405-ENG-48. *J. Histochem. Cytochem.;* **27**: No. 1, 280-283(1979).

We have investigated the accuracy with which droplets containing cells can be sorted individually onto known and thus relocatable positions. The presence and random arrival of cells and particles in the sorter jet disturbs the orderly production and deflection of droplets, causing a dispersion of sorted droplet trajectories. The magnitude of this dispersion is a function of the phase relationship between the arrival of a cell at the end of the jet and the droplet formation. Using a modified Becton Dickinson Fluorescence-Activated Cell Sorter, we selected for sorting only those droplets that formed with a cell near the center of the droplet. We used this technique to sort Lewis lung tumor cells. The dispersion of droplet positions was reduced from over 3% to about 1% of an average deflection of typically 15 mm for a nozzle with a 50-μm diameter orifice. Sorting onto a surface such as magnetic tape or a microscope slide introduces another uncertainty in position because the cell may be located anywhere within the wetted radius of the droplet on the slide. Sorting onto less-wettable surfaces reduces the wetted radius and thus the variation in cell position.

9301 **System operating characteristic and cost analysis in automated cytodiagnosis of gynecologic specimens.** Mayall, B.H. (Univ. of California, Livermore). Contract W-7405-ENG-48. *J. Histochem. Cytochem.;* **27**: No. 1, 584-590(1979).

Automated cytodiagnosis of gynecologic specimens is analogous to the engineering problem of signal detection. Misclassification gives either false positive or false negative errors. The system operating characteristic (SOC) describes system performance in terms of these two types of error. Weights are assigned to the two types of error and take into account the incidence of disease in the population and the monetary and societal costs of misdiagnosis. The overall loss due to misclassification is calculated by cost analysis and is combined with the SOC to arrive at the optimal operating point for a system. The techniques of SOC and cost analysis are illustrated by application to a preliminary study in which 54 gynecologic specimens are analyzed by flow cytometry for cellular DNA content and size. Classification is based on the number of signals corresponding to sextuploid or greater DNA content. Eleven of the specimens have abnormal but nonneoplastic cytologies and are excluded from the analysis. When the analysis is optimized to an equal weight cost structure, the false negative error rate is 2/36, the false positive error rate is 2/7, and the overall loss is 0.34relative to the cost of rescreening a woman who has been misdiagnosed as positive. The overall loss is a benchmark of system performance. It is used to compare results obtained by different systems for automated cytodiagnosis. Objective measures of classification capability are good descriptors of system performance, but other considerations, such as specimen adequacy, effect of normal cells causing false alarms, and standardization of cytodiagnostic criteria, are important in assessing the clinical acceptability of a system for automated cytodiagnosis.

9302 **Organ culture-cell culture system for studying multistage carcinogenesis in respiratory epithelium.** Steele, V.E.; Marchok, A.C.; Nettesheim, P. (Oak Ridge National Lab., TN). pp 289-300 of Carcinogeneis. Vol. 2. Mechanisms of tumor promotion and cocarcinogenesis. Slaga, T.J.; Sivak, A.; Boutwell, R.K. (eds.). New York, NY; Raven Press (1978).

An organ culture-cell culture system was used to demonstrate carcinogen dose-dependent transformation of tracheal epithelial cells in vitro. Tracheal explants were exposed to n-methyl-n'-nitro-n-nitrosoguandine (MNNG) in organ culture. Outgrowths from these explants provided epithelial cell cultures. The numbers of long-term epithelial cell cultures and cell lines that were established per explant increased as MNNG exposure concentration increased. At the present time, more cell lines derived from explants exposed to the highest MNNG concentration have produced palpable tumors than ones derived from explants exposed to lower MNNG concentrations. No cell lines were established from primaries derived from control explants. 12-0-tetradecanoyl-phorbol-13-acetate (TPA) stimulates DNA synthesis in tracheal epithelium in organ culture in a manner similar to that described for mouse skin. Not only did short exposures to TPA stimulate DNA synthesis earlier, but the stimulation was greater than that obtained with continuous exposure. At the

present time, exposure of tracheal organ culture to MNNG followed by TPA has resulted in an enhanced production of morphologically altered (MA) cells in primary epithelial cell cultures, compared to results of exposure to either agent alone.

9303 DNA single-strand lesions due to sunlight and uv light: a comparison of their induction in Chinese hamster and human cells, and their fate in Chinese hamster cells. Elkind, M.M.; Han, A. (Argonne National Lab., IL). *Photochem. Photobiol.;* **27**: 717-724(1978).

It has been shown that the lethal properties of germicidal uv light (254 nm) and sunlight-simulating near uv light are qualitatively different (Elkind et al., 1978). Further to compare these two radiations, the induction of single-strand DNA breaks (i.e. frank breaks plus alkali-labile lesions) was measured in two cell lines. Equal numbers of breaks in Chinese hamster cells require a dose of uv 5.5% of a near uv dose but in HeLa cells a uv dose of 7.6% of a near-uv dose is required. The rate of break production by these radiations is about 1/10-th of that due to x-rays when a comparison is made on an equal killing dose basis. The inventory of breaks in Chinese hamster cells was also followed and was found to be characteristically different for uv compared to near uv light. These data indicate that significant differences exist, at a molecular level, in the effects produced by ultraviolet and sunlight-simulating light, and further emphasize the need for caution in attempting to extrapolate from observed molecular or biological effects due to the former to those to be expected from the latter.

9304 Relation between DNA repair, chromosome aberrations, and sister chromatid exchanges. Wolff, S. (Univ. of California, San Francisco). pp 751-760 of DNA repair mechanisms. ICN-UCLA Symposia on molecular and cellular biology, Volume IX. Hanawalt, P.C.; Friedberg, E.C.; Fox, C.F. (eds.). New York, NY; Academic Press, Inc. (1978).

Ordinary chromosome aberrations and sister chromatid exchanges (SCEs), which are two types of cytogenetic endpoints that are currently being used to determine the effects of mutagens and carcinogens on chromosomes, differ in several aspects: (a) double stranded DNA breaks, which are induced by x rays, lead to aberrations but not to SCEs; (b) ordinary chromosome aberrations that are induced by ultraviolet light are photoreactivable, whereas we now have found in chick embryo cells that even though thymine dimers are removed by PR light, the yield of uv-induced SCEs is unaffected; (c) aberrations induced by uv or uv-like, but not x-ray like, mutagens are higher in XP cells than in normal cells, whereas SCEs are higher in XP cells after treatment with all three types of mutagens; (d) the aberration yields are related to the amount of excision repair as measured by unscheduled DNA synthesis or repair replication whereas SCE yields are not; and (e) aberrations are increased by application of caffeine after treatment with uv light or chemical mutagens but SCEs are not, and in post-replication defective XP variant cells, uv-induced SCE levels are as in normal cells. Taken as a whole, these data indicate that although aberrations are dependent upon excision repair and post-replication repair as measured in ordinary experiments, SCEs are not. The lesions that result in SCEs do not seem to be thymine dimers or alkylation products at the N^7 position of guanine. Since SCEs are induced by long-lived lesions that disappear with time, minor photoproducts, or alkylation products, that are not measured in excision repair or post-replication repair experiments seem to be the lesions responsible for SCE formation, which is contrary to the findings for chromosome aberrations.

9305 Interaction of Hoechst 33258 and BrdU substituted DNA in the formation of sister chromatid exchanges. Stetka, D.G.; Carrano, A.V. (Univ. of California, Livermore). *Chromosoma;* **63**: 21-31(1977).

Sister chromatid exchanges (SCEs) are induced in cultured Chinese hamster cells by treatment with 5-bromodeoxyuridine (BrdU) or with Hoechst 33258 (H33258) plus BrdU. The SCE frequencies depend upon the number of H33258 molecules available per cell (or per base pair) and the number of BrdU molecules available per cell, and not solely upon molarity. In addition, H33258 and BrdU act synergistically to induce SCEs. At low BrdU concentrations H33258 induces very few SCEs. At high BrdU concentrations and similar concentrations of H33258, however, SCE frequencies are significantly increased. SCE frequencies decrease with time in successively harvested cells because of the depletion of H33258 from the medium due to DNA binding.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 9294

GENETICS

REFER ALSO TO CITATION(S) 9273, 9323, 9376

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 9295

9306 Evidence for structural gene alterations affecting aminoacyl-tRNA synthetases in CHO cell mutants and revertants. Thompson, L.H.; Lofgren, D.J.; Adair, G.M. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Somatic Cell Genet.;* **4**: No. 4, 423-435(1978).

Aminoacyl-tRNA synthetase (aaRS) activities in extracts of mutant strains of the Chinese hamster ovary line (CHO) were examined for alterations in thermal stability. Mutants having low activity for MetRS, AsnRS, or GlnRS contained aaRSs that were inactivated much more rapidly upon heating than those from wild-type cells. Revertant lines, isolated from cultures of these mutants (Asn-5, Met-2, and Gln-2) after treatment with nitrosoguanidine or ethyl methanesulfonate, had thermolabilities intermediate between mutant and wild-type, and consistently had higher activities than the mutants. With a modified in vivo aminoacylation procedure, two previously exceptional mutants, Arg-l and^d His-l, showed pronounced reductions in the amount of arginyl-tRNA or histidyl-tRNA, respectively, under restrictive conditions, compared to wild type. Revertants of Arg-l (like the mutant itself) had no measurable ArgRS in vitro activity (< 0.4% of wild type) although in vivo aminoacylation in the one revertant tested was partially restored. These data provide evidence that the forward mutations have occurred in the structural genes of the aaRSs and that most of the reversions are probably the result of second-site point mutations in the aaRS genes.

METABOLISM

REFER ALSO TO CITATION(S) 8079, 9290, 9314, 9361, 9372

9307 (LBL—9895) Paths of carbon and their regulation. Bassham, J.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 22p. (CONF-791064—1). Dep. NTIS, PC A02/MF A01.

From Conference of the origins of chloroplasts, session 3, origin and evolution of the chloroplast metabolism; Washington, DC, USA (3 Oct 1979).

A comparison of the carbon pathways in photosynthetic, oxygenic bacteria, and chloroplasts from eukaryotic cells was made. The regulations of these pathways was compared. The evolution of the carbon pathways from the most primitive to more advanced forms was postulated.

MEDICINE

REFER ALSO TO CITATION(S) 9299, 9301, 9368, 9370, 9384

9308 Selected bibliography of biomedical and environmental applications of stable isotopes II-^{13}C 1971-1976. Klein, E.R. (Argonne National Lab., IL); Klein, P.D. *Biomed. Mass Spectrom.;* **5**: No. 5, 321-330(1978).

A compilation of selected references to the use of ^{13}C in biochemical, pharmacological, clinical and environmental applications for the period 1971 to 1976 is presented. Author and subject indices were also compiled.

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 9328, 9478

9309 Imaging experimental coronary artery thrombosis with indium-111 platelets. Riba, A.L. (Yale Univ., New Haven, CT); Thakur, M.L.; Gottschalk, A.; Zaret, B.L. *Circulation;* **60**: No. 4, 767-775(Oct 1979).

The ability of cardiac scintigraphy with indium-111 (^{111}In)-labeled platelets to detect coronary artery thrombosis (CAT) was assessed in a canine model. Cardiac imaging and tissue distribution studies were performed shortly after administering ^{111}In-labeled platelets to 12 dogs (group 1) with acute CAT. Four dogs (group 2) with acute CAT were studied 2 and 22 hours after administering ^{111}In platelets. In addition, four dogs (group 3) with 24-hour-old CAT were similarly evaluated. In all group 1 animals, in vivo imaging 1 to 2 hours after ^{111}In platelet administration revealed intense uptake in the region of thrombus-containing left anterior descending arteries that was readily discernible from background blood pool activity. Sequential imaging of the four group 2 animals over a 22-hour period revealed no change in the scintigraphic pattern of the thrombosed arteries. In contrast, ^{111}In platelet imaging in the four group 3 animals with 24-hour-old CAT failed to reveal enhanced activity within the region of the thrombus-containing

coronary artery. In the 12 group 1 animals, the CAT accumulated 69 +- 10 (mean +- SEM) times greater activity than present in blood and 651 +- 135 times greater activity than normal left ventricular myocardium. There was 24 +- 7 times greater ^{111}In activity in the damaged left anterior descending arteries compared with normal circumflex arteries. Similar uptake ratios were seen in group 2 animals. The 24-hour old thrombi from group 3 animals showed no enhanced ^{111}In uptake. This study demonstrates that experimental acute CAT can be detected readily with ^{111}In platelet cardiac scintigraphy.

9310 Emission tomography. Atkins, H.L. (Brookhaven National Lab., Upton, NY). *N.Y. State J. Med.;* **79**: No. 9, 1355-1359(Aug 1979).

Emission tomography is a method for producing transaxial planar images of radionuclide distribution in sections of the body. Both single-photon emitting and positron emitting methods have been developed. Coincidence detection of short-lived positron emitting radionuclides has the advantage of good attenuation correction so that true quantitative determination of radioactivity concentration is possible. In addition, organic molecules of medical interest can be labeled with radionuclides such as carbon-11 or nitrogen-13, which do not affect biologic behavior. The advantage of single-photon systems is that conventional radiopharmaceuticals, such as those labeled with technetium-99m, can be used. Unfortunately, these materials do not measure metabolism. Both methods are still in an early stage of development and do not, as yet, have a well-defined clinical role.

EXTERNAL RADIATION IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 9327

EXTERNAL RADIATION IN THERAPY

REFER ALSO TO CITATION(S) 9327, 9479, 9480

MICROBIOLOGY

REFER ALSO TO CITATION(S) 8061, 8079, 8226, 8283, 9322, 9323, 9337

9311 (LBL—9064) Interrelations of transformation, virus replication, and differentiated functions in cultured chick cells. Soo, W.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 212p. Dep. NTIS, PC A10/MF A01.

Thesis.

Previous studies demonstrated that chick tendon cells can be transformed by Rous sarcoma virus as judged by standard criteria of altered morphology, loss of density-dependent growth control and increase in 2-deoxy-D-glucose uptake and that collagen synthesis by these cells drops drastically upon transformation. To study the time course of this event, the change in collagen synthesis after transformation by a temperature-sensitive mutant of the virus was followed. This change is then compared to changes in other cellular properties. The mechanism by which collagen synthesis is regulated after transformation has also been investigated in this thesis. The effect of 2-deoxy-D-glucose on the cellular metabolism of chick embryo fibroblasts as well as on the replication of Rous sarcoma virus in infected chick cells was studied in this project. A possible relationship between host cellular metabolism and virus replication was also explored.

9312 Studies on quantitative physiology of Trichoderma reesei with two-stage continuous culture for cellulase production. Ryu, D.; Andreotti, R.; Mandels, M.; Gallo, B.; Reese, E.T. (Army Natick Research and Development Command, MA). E4928-1007. *Biotechnol. Bioeng.;* **21**: No. 11, 1887-1903(Nov 1979).

By employing a two-stage continuous-culture system, some of the more important physiological parameters involved in cellulase biosynthesis have been evaluated with an ultimate objective of designing an optimally controlled cellulase process. The two-stage continuous-culture system was run for a period of 1350 hr with Trichoderma reesei strain MCG-77. The temperature and pH were controlled at 32°C and pH 4.5 for the first stage (growth) and 28°C and pH 3.5 for the second stage (enzyme production). Lactose was the only carbon source for both stages. The ratio of specific uptake rate of carbon to that of nitrogen, Q(C)/Q(N), that supported good cell growth ranged from 11 to 15, and the ratio for maximum specific enzyme productivity ranged from 5 to 13. The maintenance coefficients determined for oxygen, M_o, and for carbon source, M/sub c/, are 0.85 mmol O_2/g biomass/hr and 0.14 mmol hexose/g biomass/hr, respectively. The yield constants determined are: Y/sub X/O/ = 32.3 g biomass/mol O_2, Y/sub X/C/ = 1.1 g biomass/g C or Y/sub X/C/ = 0.44 g biomass/g hexose, Y/sub X/N/ = 12.5 g biomass/g nitrogen for the cell growth stage, and Y/sub X/N/ = 16.6 g biomass/g nitrogen for the enzyme production stage. Enzyme was produced only in the second stage. Volumetric and specific enzyme productivities obtained were 90 IU/liter/hrand 8 IU/g biomass/hr, respectively. The maximum specific enzyme productivity observed was 14.8 IU/g biomass/hr. The optimal dilution rate in the second stage that corresponded to the maximum enzyme productivity was 0.026 approx. 0.028 hr^{-1}, and the specific growth rate in the second stage that supported maximum specific enzyme productivity was equal to or slightly less than zero.

9313 Laboratory studies of in vivo fluorescence of phytoplankton. Brown, C.A. Jr.; Farmer, F.H.; Jarrett, O. Jr.; Staton, W.L. (National Aeronautics and Space Administration, Hampton, VA). pp 782-788 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Laboratory studies were conducted to determine the in vivo fluorescence of phytoplankton. Representative species of each of the four major phytoplankton color groups were investigated with two significant results. Fist, there is a similarity between the fluorescent properties within a color group and secondly, there is a distinct spectral difference between color groups. Chlorophyll a in vivo fluorescence peaks at 685 nm and the magnitude of this fluorescence is dependent on the excitation wavelength and the color group to which the phytoplankton belongs. No single excitation wavelength can efficiently excite phytoplankton belonging to all four color groups. Therefore, to determine the concentration and diversity of the phytoplankton population, a LIDAR system with four sequentially pulsed dye lasers operating at four different wavelengths is used. Tests were conducted on single and multispecies cultures of phytoplankton during growth in a 100 liter tank. Six different laboratory tests have been performed using a mixture of two, three, and four phytoplankton species. During each test, the phytoplankton were grown in a sea water media and the non-lidar parameters, cell count, total chlorophyll a, in vivo fluorescence and light attenuation, were determined. A linear model was derived to compute the fluorescence of chlorophyll a and the relative diversity of each of the color groups from LIDAR parameters. Very good correlation between the LIDAR measured fluorescence and both in vivo fluorescence and extracted chlorophyll a has been obtained under the controlled conditions of the laboratory.

9314 Production of a high viscosity glucan by Sclerotium rolfsii ATCC 15206. Griffith, W.L.; Compere, A.L. (Oak Ridge National Lab., TN). *Dev. Ind. Microbiol.;* **19**: 609-617(1978).

Sclerotium rolfsii ATCC 15206 produces a high viscosity glucan polymer when cultured on a medium containing salts, glucose, and a trace of yeast extract. The polymer produced is comparable in viscosity per unit dry weight to xanthan gum. Polymer production, organism biomass, reducing sugar, and nitrate consumption were followed during the course of 5-day fermentations under varying incubation conditions. The highest polymer yield during fermentation runs was 1.5% (w/v), which represents a 50% conversion of the feed glucose.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 9293

PATHOLOGY

REFER ALSO TO CITATION(S) 9370, 9372, 9373

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 9328, 9370, 9371, 9372, 9373, 9375

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 9309

9315 Quercetin inhibits hexose transport in a human diploid fibroblast. Salter, D.W.; Custead-Jones, S.; Cook, J.S. (Oak Ridge National Lab., TN). *J. Membr. Biol.;* **40**: 67-76(1978).

The flavonol quercetin, a phloretin analog, inhibits transport of 2-deoxyglucose and 3-O-methylglucose in a cultured human diploid fibroblast. This inhibition is related to transport itself and not to the reported effects of flavonoids on membrane-bound ATPases. From concentration-inhibition curves at several pH's we conclude that uncharged (acid) quercetin (pH = 7.65) is the inhibitory form of the molecule (K/sub I/ = 10 μm). Quercetin, unlike phloretin, is rapidly degraded in 0.1 N NaOH; the degradation products are weakly inhibitory to hexose transport.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 9215, 9384

9316 (NP—24018) **Ecological distribution of 1000 economic plants.** Duke, J.A.; Hurst, S.J.; Terrell, E.E. (Agricultural Research Service, Beltsville, MD (USA). Plant Taxonomy Lab.). Nov 1975. 36p. Dep. NTIS, PC A03/MF A01.

Data resulting from more than 500 questionnaires are tabulated on 1000 economic plants, giving their life form and indicating, what life zones, pH, light, precipitation, and temperature regimes they have been reported to tolerate. The few yield data available have been roughly translated into comparable energetic units.

9317 **Effects of localized ultrasonic irradiation on Pisum sativum roots.** Law, W.K.; Carstensen, E.L.; Miller, M.W. (Univ. of Rochester, NY). *Environ. Exp. Bot.;* **18**: 207-218(1978).

Histological studies on pea roots sonicated by a broad beam of ultrasound indicated that most of the damage occurs in the elongation region. There is little microscopic evidence of cell destruction in the meristem, and yet this region of dividing cells shows a marked cytokinetic response to sonication. Indirect effects of ultrasound were therefore suspected to exist. By using focused ultrasound to irradiate root segments as small as 1 mm^2, and then observing changes in growth and mitotic index outside the region of sonication, the existence of indirect effects of ultrasound was established. Histological observations on sections of treated roots indicated necrotic nuclei within and without the region of sonication.

9318 **Seasonal changes in respiratory metabolism of yellow-poplar (Liriodendron tulipifera) branches.** McLaughlin, S.B.; McConathy, R.K.; Dinger, B.E. (Oak Ridge National Lab., TN). *J. Appl. Ecol.;* **15**: 327-334(1978).

The rates of CO_2 and O_2 exchange, calculated respiratory quotients, and tissue moisture contents of detached yellow-poplar (Liriodendron tulipifera) branches were studied during an annual cycle. Average respiration of current year twigs (315 mg CO_2 m^{-2} h^{-1}) was considerably higher during the growing season than that of older branches (175 mg CO_2 m^{-2} h^{-1}). The respiration rates of current year twigs and older branches followed a similar pattern of change during the growing season. Changes in respiratory quotients agreed well with expected changes in respiratory substrate, based on the phenology of yellow poplar. Changes in respiratory metabolism were significantly correlated with changing moisture content of older tissues, however, distinct seasonal differences in the influence of tissue moisture were noted. The high respiratory activity and large surface area of small branches and twigs indicates that they should be considered important in any attempt to quantify gas exchange and energy flow through forested ecosystems.

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

REFER ALSO TO CITATION(S) 9272

9319 (UR—3490/LCP-18) **ESR-ENDOR study of x-irradiated single crystals of α-D-glucopyranose and α-methyl-D-glucopyranoside; environmental effects upon radiation and free radical chemistry in carbohydrate model systems.** Madden, K.P. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-C-02-3490. 173p. Dep. NTIS, PC A08/MF A01.

Thesis.

Single crystals of x-irradiated α-D-glucopyranose (αGlu) and α-methyl-D-glucopyranoside (αMeGlu) were studied to determine products and reaction mechanisms in carbohydrate radiation and free-radical chemistry. Four free-radical products were identified in αMeGlu single crystals at 77K; a reoriented 06 primary alkoxy radical (06RPA), an 02 secondary alkoxy radical (02SA), a deprotonated C6 primary hydroxyalkyl radical (C6DPH), and a C5 secondary oxyalkyl radical (C5S0). Irradiation and observation at 12K produced an unreoriented 06 primary alkoxy radical (06PA). Four free radicals were identified in αGlu single crystals at 12K and 77K; two different 02 secondary alkoxy radicals (02SA and 02SA′), a C6 primary hydroxyalkyl radical (C6PH), and a C3 secondary hydroxyalkyl radical (C3SH). Study of the free radical environment about 06 in αGlu and αMeGlu indicated that the 06-H(06) bond in αMeGlu has considerably more ionic character than its counterpart in αGlu. The presence of an additional hydrogen bond to 06 in αMeGlu was used to explain the reorientation of the 06PA radical, and the stability of this species in the αMeGlu host crystal. Free radical reactions in αGlu and αMeGlu were induced by slowly warming crystals irradiated at 77K until conversion occurred. In αMeGlu, the major reaction sequence was C6DPH → C550 → C2 primary hydroxyalkyl radical (C2PH) → room temperature allylic radical. In αMeGlu, the major pathway is C6PH → C2PH → C2 secondary hydroxylkyl radical (C2SH). Environmental influences upon these free-radical reaction mechanisms are discussed. The results from previous work on irradiated aqueous glasses of αGlu are briefly reviewed, and compared to those obtained from the single crystal system. (ERB)

IN ANIMALS

REFER ALSO TO CITATION(S) 9324

RADIATION EFFECTS ON CELLS

REFER ALSO TO CITATION(S) 9304

EXTERNAL SOURCE

REFER ALSO TO CITATION(S) 9303

9320 (CONF-790977—2) **Repair of radiation damage in mammalian cells: its relevance to environmental effects.** Han, A.; Elkind, M.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 17p. Dep. NTIS, PC A02/MF A01.

From Conference on health effects of energy production; Ontario, Canada (12 Sep 1979).

Assessment of the potential biological hazards associated with energy production technologies involves the quantitation of risk on the basis of dose-effect dependencies, from which, it is hoped, some safety guidelines can be developed. Our current knowledge of the biological importance of damage/repair processes stems by and large from radiation studies which clearly demonstrate that cellular response to radiation depends upon the ability of cells to repair the damage. Apparently, the same is true for cellular response to different chemical agents. Drawing upon our experiences from radiation studies, we demonstrate the relevance of ongoing repair processes, as evident in the studies of radiation induced cell killing and neoplastic transformation, to the type of risk estimates that might be associated with the hazards from energy production technologies. The effect of repair on cell survival is considered. It is evident from our studies that in the region of small doses, repair of damage relative to cell lethality is of importance in estimating the magnitude of effect. Aside from the cytotoxic effects in terms of cell killing, one of the greatest concerns associated with energy production is the potential of a given technology, or its effluents, to produce cancer. It is therefore of importance to quantify the risk in this context of damage registration and possible effect of repair on damage expression. It has been generally established that exposure of normal cells in culture to a variety of known carcinogens results in neoplastic transformation. Our observations with C3H/10T1/2 cells in culture lend direct evidence for the hypothesis that reduced tumor incidences at low dose rates of radiation could be due to the repair of induced damage.

9321 **Inactivation of human kidney cells by high-energy monoenergetic heavy-ion beams.** Blakely, E.A.; Tobias C.A.; Yang, T.C.H.; Smith, K.C.; Lyman, J.T. (Univ. of California, Berkeley). *Radiat. Res.;* **80**: No. 1, 122-160(Oct 1979).

Presented are fundamental data on the biological effects of monoenergetic beams of carbon (400 MeV/amu), neon (425 MeV/amu), and argon (570 MeV/amu). Cell survival of human kidney T-1 cells was measured under aerobic and hypoxic conditions over a range of mean LET∞ from 10 to 600 keV/μm. RBE and OER were measured under hypoxic and aerobic conditions with attention paid to dose, mean LET∞, and particle charge effects. (DS)

RADIATION EFFECTS ON MICROORGANISMS

9322 **Water as a modulator of radiation damage to microorganisms.** Powers, E.L. (Univ. of Texas, Austin). Contract E-(40-1)-3408. pp 97-118 of Sterilization of medical products by ionizing radiation. Gaughran, E.R.L.; Goudie, A.J. (eds.). Montreal, Canada; Multiscience Publishers Ltd. (1978).

The optimization of the sterilizing actions of ionizing radiation against bacterial spores is discussed in terms of the role of water in the radiation induced effects of these microorganisms. In the dry spore, which is the most sensitive state in O_2, three classes of damage are recognized, one O_2-independent and two O_2-dependent, and each responds differently to added water: anoxic sensitivity increases at highest water contents as water monolayer formation is complete, and both O_2-dependent effects are reduced, with the

component due to a long-lived free radical interaction with O_2 being lost at saturation. The response to radiation of spores suspended in aqueous solutions is shown to be dependent on the redox potential and the concentration of added solutes. In this light, the effects of the radiation sensitizers, Ag^+, biacetyl, cobalt hexammine and O_2 are discussed and their relationship to damage induced by .OH considered.

BASIC STUDIES

9323 (UR—3490/LCP-19) **Characterization of an MMS sensitive mutant of Saccharomyces cerevisiae.** Martin, P.S. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-C-02-3490. 318p. Dep. NTIS, PC A14/MF A01.

Thesis.

We have characterized a methyl methanesulfonate sensitive mutant of the yeast Saccharomyces cerevisiae in order to learn more about DNA repair and mutagenesis in this organism. The mutation, designated mms3-1, also confers sensitivity to ultraviolet light and to ethyl methanesulfonate in both haploids and homozygous diploids. Its effect on γ-ray sensitivity, however, is a function of the ploidy of the cell and its effect on induced mutation is a function of both the ploidy of the cell and the nature of the inducing agent. Our major findings are discussed. Our data indicate that: (1) Saccharomyces cerevisiae has an error prone pathway for the repair of uv damage controlled by the MMS3 gene product operating in and only in, and possibly induced by conditions present only in, a/α diploids; (2) in diploids, at least, there exists at least one step in the error prone repair of uv induced damage which is different from a step in the error prone repair of EMS induced damage; (3) a/α mms3-1/mms3-1 diploids may be defective in a step common to the repair of mutagenic lesions following uv irradiation and lethal lesions following γ irradiation; and (4) there are steps in the repair of MMS induced lethal damage that are different from steps in the repair of EMS induced lethal damage.

9324 **Oxygen dependence of sensitization to 254-nm radiation by prior exposure to 365-nm radiation in strains of Escherichia coli K12 differing in DNA repair capability.** Webb, R.B.; Brown, M.S. (Argonne National Lab., IL). *Radiat. Res.;* **80**: No. 1, 82-91(Oct 1979).

Near-ultraviolet radiaton (320 to 400 nm) can produce both lethal and mutagenic effects in bacteria and other biological systems. It has been proposed that biological effects associated with DNA lesions produced by far-uv, near-uv, and x radiation are enhanced by near-uv damage to the DNA repair systems. The relationships between oxygen dependence of enhancement of sensitivity to 254-nm radiation by prior irradiation at 365 nm and the oxygen dependence of inactivation by 365-nm radiation were investigated in strains of Escherichia coli K12 differing in DNA repair capability. The oxygen enhancement ratios (OER) of the four E. coli K12 strains tested, based on 365-nm F_{10} values, were as follows: AB1157 (wild type), 3.9; AB1886 (uvrA rec$^+$), 3.3; AB2463 (uvr$^+$ recA), 4.6; and AB2480 (uvrA recA), 1.04. A large oxygen enhancement also was observed for the 365-nm induced increase in 254-nm lethality in strains AB1157 and AB1886. However, the oxygen enhancement for the recA strain AB2463 was complex: in stationary-phase cells with 365-nm fluences below 8.0 X 10^5 J m^{-2}, no oxygen dependence was observed for the 365-nm-induced decrease in 254-nm inactivaton, while with 365-nm fluences greater than 8.0 x 10^5 J m^{-2}, a strong oxygen enhancement of the increase in 254-nm inactivation was observed. In exponential-phase cells of strain AB2463, a large oxygen dependence occurred for both photoprotection and for the 365-nm-induced increase in sensitivity to 254-nm radiation. It is concluded that oxygen-dependent damage to repair processes contributes significantly to the oxygen-dependent lethality at 365 nm. These results do not exclude a contribution of oxygen-dependent DNA lesions to 365-nm lethality.

9325 **8-methoxypsoralen effects on survival and repair of Escherichia coli after ultraviolet irradiation: action spectra.** Hass, B.S.; Webb, R.B. (Argonne National Lab., IL). *Radiat. Res.;* **80**: No. 1, 170-185(Oct 1979).

The action spectra of two strains of Escherichia coli over the wavelength range of 254 to 390 nm has been obtained in the presence of 8-methoxypsoralen (8-MOP). Strains WP2 (wild-type) and WP2Hcr(uvrA) showed greatly enhanced (10^{2*} to 10^3-fold) photosensitivity from 390 to 310 nm, the greatest effect appearing at 320 to 335 nm. At wavelengths from 300 to 254 nm the presence of 8-MOP produced no effect on lethal sensitization with WP2Hcr cells, but the WP2 strain exhibited a two-fold protection when 8-MOP was present. 8-MOP has a major absorption peak at 304 nm, the region of the least biological effect. The large shoulders on the survival curves of untreated cells of both strains irradiated at wavelengths above 300 nm was significantly diminished by the presence of 8-MOP. If such shoulders are caused by fluence-dependent repair processes, using the reciprocal of the shoulder fluence, F/sub q/, as a measure of the rate of production of sublethal damage, it appears that 8-MOP-sensitized damage is not repaired as efficiently as damage induced in the absence of 8-MOP. Two small regions in the action spectra were exceptions to this generality: the region of 300 to 315 nm for the WP2Hcr strain and of 300 to 285 nm for the WP2 strain.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 9215, 9320, 9478, 9479, 9480

9326 (ORNL/TM—5805) **Congenital malformation and fetal mortality trends in counties surrounding Oak Ridge.** Shank, K.E.; Easterly, C.D.; Oakes, T.W. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 54p. Dep. NTIS, PC A04/MF A01.

Stillbirth and congenital malformation death data have been evaluated for counties surrounding the Oak Ridge nuclear facilities. The observed values were compared with expected values, based on state of Tennessee and East Tennessee rates, for three time periods: prior to the existence of the nuclear facilities; the early years of operation; and the later years of operation. Oak Ridge, which is the closest city to the nuclear facilities, had significantly fewer stillbirths and no difference in congenital malformations as compared with the state or East Tennessee. No time trend was observed in the 8-county data which could be associated with the higher levels of radioactive releases during the 1944 to 1957 period followed by a period of lesser releases in the 1958 to 1971 period. However, a clustering of stillbirths was found for the last time period. In the study, no significant relationship was found between the occurrence of stillbirths and congenital malformation deaths.

9327 **Static pion beam treatment planning of deep seated tumors using computerized tomographic scans.** Hogstrom, K.R. (Univ. of New Mexico, Albuquerque); Smith, A.R.; Simon, S.L. *Int. J. Radiat. Oncol., Biol. Phys.;* **5**: No. 6, 875-886(Jun 1979).

Static negative pion beam treatment of deep seated tumors is in progress at LAMPF. The influence of the physical principles of pions on treatment planning, e.g., an enhanced peak dose, multiple scattering, variations of beam quality, pion beam emittance, and a fixed vertical beam, are discussed. Computerized tomographic (CT) scan data have proven invaluable in providing quantitative information on inhomogeneities within the anatomy. The methods of designing collimation and compensating bolus for tailoring the pion beam to individual patient ports are described. An interim method, using dosimetry measurements in a water phantom and CT scan data to construct patient isodose distribution is outlined. Typical treatment plans for patients with abdominal and head and neck cancers are presented. The method of x-ray simulation in verifying localization of CT-defined tumor volumes is demonstrated for the head and neck.

VERTEBRATES

9328 (ANL—79-90) **Division of Biological and Medical Research annual report 1978.** Rosenthal, M.W. (ed.). (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 236p. Dep. NTIS, PC A11/MF A01.

The research during 1978 in the Division of Biological and Medical Research, Argonne National Laboratory, is summarized. Studies related to nuclear energy include responses of beagles to continuous low-level ^{60}Co gamma radiation, and development of leukemic indicators; comparison of lifetime effects in mice of low-level neutron and ^{60}Co gamma radiation; genetic effects of high LET radiations; and metabolic and therapeutic studies of heavy metals. Studies of nonnuclear energy sources deal with characterization and toxicological evaluation of effluents of fluidized bed combustion and coal gasification; electrical storage systems; electric fields associated with energy transmission; and development of population projection models and assessment of human risk. Basic research studies include fundamental structural and biophysical investigations; circadian rhythms; mutagenesis in bacteria and mammalian cells; cell killing, damage, and repair in mammalian cells; carcinogenesis and cocarcinogenesis; the use of liposomes as biological carriers; and studies of environmental influences on life-span, physiological performance, and circadian cycles. In the area of medical development, proteins in urine and tissues of normal and diseased humans are analyzed, and advanced analytical procedures for use of stable isotopes in clinical research and diagnosis are developed and applied. The final sections of the report cover support facilities, educational activities, the seminar program, staff talks, and staff publications.

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 8179, 8950

9329 (EML—363, pp I.125-I.138) **Strontium-90 in human bone: 1978 results for New York City and San Francisco.** Klusek, C.S. 1 Oct 1979.

In Environmental Measurements Laboratory environmental quarterly, June 1-September 1, 1979.

Results are presented of determinations of Sr-90 content of 80 specimens of vertebrae obtained during 1978 in New York City and San Francisco. The average Sr-90 to Ca ratios for adult vertebrae are 1.02 pCi/g Ca in New York and 0.64 pCi/g Ca in San Francisco. The average values remained unchanged from the previous year. Average Sr-90 concentrations in children's bone are now little different from the adult values. A two compartment bone model, which accounts for both short- and long-term retention of Sr-90 in bone, is used to describe the variations of Sr-90 content of bone and provide correlation with dietary Sr-90 intake. Regression analysis of the 18 years of survey data provides values of the relative retention of dietary Sr-90 and the effective bone turnover rates. The bone model gives satisfactory description of observed Sr-90 levels and allows reliable assessment of the long-term behavior of Sr-90 in man. Results of measurements of Sr-90 content of foods purchased in New York and San Francisco for the first quarter of 1979 are tabulated and presented in the section of EML Environmental Program Data.

9330 (ORNL—5528) **Uncertainty associated with selected environmental transport models.** Little, C.A.; Miller, C.W. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 56p. Dep. NTIS, PC A04/MF A01.

A description is given of the capabilities of several models to predict accurately either pollutant concentrations in environmental media or radiological dose to human organs. The models are discussed in three sections: aquatic or surface water transport models, atmospheric transport models, and terrestrial and aquatic food chain models. Using data published primarily by model users, model predictions are compared to observations. This procedure is infeasible for food chain models and, therefore, the uncertainty embodied in the models input parameters, rather than the model output, is estimated. Aquatic transport models are divided into one-dimensional, longitudinal-vertical, and longitudinal-horizontal models. Several conclusions were made about the ability of the Gaussian plume atmospheric dispersion model to predict accurately downwind air concentrations from releases under several sets of conditions. It is concluded that no validation study has been conducted to test the predictions of either aquatic or terrestrial food chain models. Using the aquatic pathway from water to fish to an adult for ^{137}Cs as an example, a 95% one-tailed confidence limit interval for the predicted exposure is calculated by examining the distributions of the input parameters. Such an interval is found to be 16 times the value of the median exposure. A similar one-tailed limit for the air-grass-cow-milk-thyroid for ^{131}I and infants was 5.6 times the median dose. Of the three model types discussed in this report,the aquatic transport models appear to do the best job of predicting observed concentrations. However, this conclusion is based on many fewer aquatic validation data than were availaable for atmospheric model validation. (JGB)

ANIMALS

REFER ALSO TO CITATION(S) 9309

9331 **Action of DTPA on hepatic plutonium. III. Evidence for a direct chelation mechanism for DTPA-induced excretion of monomeric plutonium into rat bile.** Bhattacharyya, M.H.; Peterson, D.P. (Argonne National Lab., IL). *Radiat. Res.;* **80**: No. 1, 108-115(Oct 1979).

Trisodium calcium diethylenetriaminepenta[2-^{14}C]acetic acid ([^{14}C]DTPA, 0.25 nmole/kg, 0.210 mCi/mmole) was administered via the jugular vein to three rats whose bile ducts and urinary bladders were cannulated. Bile and urine were collected for 24 h after injection, and tissues and excreta were then analyzed for ^{14}C content. [^{14}C]DTPA was identified in the bile samples by cochromatography with unlabeled DTPA on an anion-exchange column system. Data from this experiment demonstrated the existence of a minor excretion pathway for DTPA into rat bile, accounting for 0.12% of the injected dose by 24 h after administration. Bile was collected for 24 h following the administration of unlabeled Na_3[CaDTPA] (0.25 mmole/kg, iv) to a rat which had received ^{239}Pu(IV)-citrate (5.7 μCi/kg, iv) 24 h prior to DTPA. Bile samples containing Pu were analyzed using anion-exchange column chromatography. Eighty to ninety percent of the Pu present in bile chromatographed as a single peak in the position of the Pu-DTPA complex. Cochromatograhy of the 0- to 6-h bile sample with a ^{239}Pu-[^{14}C]DTPA complex revealed that the Pu appearing in bile following DTPA treatment comigrated with the ^{239}Pu-[^{14}C]DTPA complex. These data provide strong evidence that, in the rat, DTPA acts to remove hepatic deposits of monomeric Pu by formation of the Pu-DTPA complex followed by excretion of the complex into bile.

9332 **Influence of oxidation state on the absorption of plutonium from the gastrointestinal tract.** Sullivan, M.F.; Ryan, J.L.; Gorham, L.S.; McFadden, K.M. (Pacific Northwest Lab., Richland, WA). *Radiat. Res.;* **80**: No. 1, 116-121(Oct 1979).

A study was made of the effect of oxidation state on gastrointestinal absorption of plutonium using solutions that contained, or did not contain, a strong oxidant and animals that were or were not fasted. There was no appreciable difference in the absorption of intragastrically injected ^{238}Pu(IV) and ^{239}Pu(VI) by either rats or guinea pigs allowed food ad libitum and injected. To determine if the conditions used by Weeks et al., (Radiat. Res. 4, 339-347, 1956) were responsible for the increased gut absorption of ^{239}Pu(VI), relative to Pu(IV), both fasted and unfasted rats were gavaged with acid solutions of ^{239}Pu(VI) nitrate, in the presence or absence of the holding oxidant ($K_2Cr_2O_7$). The results indicated that the combination of dichromate and fasting increased absorption about 26-fold.

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 8909, 8910, 9272, 9328

9333 **Chemical carcinogenesis.** Calvin, M. (Univ. of California, Berkeley). *Prog. Biochem. Pharmacol.;* **14**: 6-27(1978).

Chemical carcinogenesis is a term which is used to describe the fact that many kinds of natural and synthetic chemicals present in or environment could conceivably be components in the triggering, or genesis, of malignancy. It has been known for over 100 years that a component of soot is indeed a principal source of certain kinds of cancer, and it has been known for the last 20 years which component of soot is most active in this regard. Since this early recognition, the number of chemicals (natural and synthetic) which have been designated carcinogens has increased enormously, usually by virtue of some kind of epidemiological study or more recently and, more frequently, by deliberate screening programs with animals of various kinds. The structure of today's discussion is: First, is there any chemical event, or common chemical property, of these chemical materials which has been recognized and is there any common chemical reaction which they perform; and, secondly, is there any common mechanism of achieving the biological consequences which we know these chemicals have?

CELLS

REFER ALSO TO CITATION(S) 9290, 9302, 9320

9334 **Comparative mutagenicity of alkylsulfate and alkanesulfonate derivatives in Chinese hamster ovary cells.** Couch, D.B.; Forbes, N.L.; Hsie, A.W. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Mutat. Res.;* **57**: 217-224(1978).

Mutation induction and cell killing produced by selected alkylsulfates and alkanesulfonates have been quantitated using the Chinese hamster ovary/hypoxanthine-guanine phosphoribosyl transferase (CHO/HGPRT) system. Dose-response relationships of cytotoxicity and mutagenicity are presented for two alkylsulfates [dimethylsulfate (DMS), diethylsulfate (DES)] and three alkyl alkanesulfonates [methyl methanesulfonate (MMS), ethyl methanesulfonate (EMS), and isopropyl methanesulfonate (iPMS)]. Under the experimental conditions employed, cytotoxicity decreased with the size of the alkyl group. DMS was more toxic than DES, and MMS was more toxic than EMS and iPMS. All agents produced linear dose-response of mutation induction: DMS was more mutagenic than DES, and MMS was more mutagenic than EMS and iPMS based on mutants induced per unit mutagen concentration. However, the following relative mutagenic potency was observed when comparisons were made at 10% survival: DES > DMS; EMS > MMS > iPMS.

9335 **Mutagenicity and cytotoxicity of congeners of two classes of nitroso compounds in Chinese hamster ovary cells.** Couch, D.B.; Hsie, A.W. (Oak Ridge National Lab., TN). *Mutat. Res.;* **57**: 209-216(1978).

The induction of mutation by certain nitrosamidines and nitrosamides has been quantitated utilizing the hypoxanthine-guanine phosphoribosyl transferase (HGPRT) locus in Chinese hamster ovary cells. Dose-response relationships for cytotoxicity and mutagenicity are presented for N-methyl-N-nitrosourea (MNU), N-ethyl-N-nitrosourea (ENU), N-butyl-N-nitrosourea (BNU), N-methyl-N'-nitro-N-nitrosoguanidine (MNNG), and N-ethyl-N'-nitro-N-nitrosoguanidine (ENNG). Based on the concentration of each agent required to kill 90% of the cells, the following order of cytotoxicity was observed: MNNG > ENNG > MNU > ENU > BNU. This is

the same order of potency as observed for mutation induction per unit concentration of mutagen.

MICROORGANISMS

REFER ALSO TO CITATION(S) 8061, 9323

9336 (EPA/600/9—78-022, pp 29-50) **Status of bioscreening of emissions and effluents from energy technologies.** Waters, M.D. (Environmental Protection Agency, Research Triangle Park, NC); Epler, J.L. Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

Short-term tests with bacterial and yeast mutagenicity assays appear to detect effectively the mutagenic potential of complex environmental or industrial effluents; however, chemical fractionation is necessary to reduce toxicity and concentrate hazardous materials. Extension of the results to higher organisms, i.e., mammalian cells, Drosophila, and the mouse, appears to be valid but needs more testing. In these initial feasibility studies, results show that biological testing - within the limits of the specific system used - can be carried out with complex organic materials, but perhaps only when coupled with the appropriate analytical separation schemes. The detection or perhaps the generation of mutagenic activity may well be a function of the chemical fractionation scheme utilized. As a prescreen to aid the investigators in ordering their priorities, the short-term testing appears to be a valid testing approach with complex mixtures. Several general conclusions may be reached on the basis of the research. Short term bioassays are being applied effectively to energy related samples as indicators of potential healh effects. These tests facilitate rapid prioritization of samples for further evaluation by conventional biological and chemical methodologies. The bioassays are useful as a means to direct the chemical fractionation and identification of hazardous components of complex mixtures. Chemical fractionation may be required for the demonstration of genetic or genotoxic activity in complex mixtures which contain interfering toxic components. The prediction of relative toxicity on the basis of chemical analytical results is subject to error. However, chemical analyses are, in general, quantitatively more sensitive than are the health effects bioassays. The results of chemical and biological analysis are complementary and together provide useful information not obtainable when the two approaches are applied separately.

9337 **Physical factors affecting the mutagenicity of fly ash from a coal-fired power plant.** Fisher, G.L.; Chrisp, C.E.; Raabe, O.G. (Univ. of California, Davis). *Science;* **204**: 879-881(25 May 1979).

The two finest, most respirable coal fly ash fractions collected from the smokestack of a power plant were more mutagenic than two coarser fractions. Mutagenicity was evaluated in the histidine-requiring bacterial strains TA 1538, TA 98, and TA 100 of Salmonella typhimurium. Ash samples collected from the hoppers of an electrostatic precipitator in the plant were not mutagenic. The mutagens in coal fly ash were resistant to x-ray or ultraviolet irradiation, possibly as a result of stabilization by fly ash surfaces. All mutagenic activity is lost with heating to 350°C.

9338 **Effect of atmospheric pollutants on the microbial decomposition process of an arid ecosystem.** States, J.S. (Northern Arizona Univ., Flagstaff). pp 54-56 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Several aspects of the decomposer compartment of a cool-desert grassland have been defined with the purpose of determining the effects of atmospheric pollutants on the microbial decomposer process. Positive relationships between the amount and kind of organic matter, rates of carbon dioxide evolution, and the abundance and diversity of the decomposer community were established. These relationships were found to be seasonally constant despite the extreme environmental heterogeneity encountered in this arid ecosystem. In laboratory studies the soils demonstrated a high and efficient sorptive capacity for atmospheric sulfur and nitrogen dioxides. Significant but minor chemical and biological changes occurred when the soils were fumigated with these gases at low ambient concentrations (0.35 to 5.0 ppM). Bacterial numbers decreased in soil where shifts in pH occurred following fumigation. Dominant and characteristic grassland fungi showed marked response to fumigation through decreased spore germination. Data indicate that predictions of the effects of gaseous emissions on the decomposer compartment in an arid grassland can be made.

PLANTS

REFER ALSO TO CITATION(S) 9068, 9205

9339 (CONF-791009—20) **Identifying the potential for SO_2-induced vegetation damage in the evaluation of energy policy scenarios.** Ballou, S.W.; Irving, P.M.; Gabriel, M.H.; Robeck, K.E. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Environmental assessments of future conventional and non-conventional energy technologies are routinely conducted by the DOE and other Federal agencies. This work is usually done at broad spatial scales ranging from a county level to state, regional, or national levels of analysis. A case study is presented that uses a screening process which identifies potential SO_2 damage to crops and natural vegetation to highlight problems and to present possible approaches of conducting ecological assessments at unspecified sites. As a first approximation of impact, the screening process identifies potential crop and natural vegetation damage from projected SO_2 emissions. This process relies on existing data bases for SO_2 threshold values for crop damage and on the geographical location of SO_2 sensitive vegetation; 1975-measured and 1990-projected ambient SO_2 levels for energy and industrial sources provide the basis for identifying potential impact areas. A recent analysis of the PIES Mid-Mid Range Scenario indicates fewer areas with potential crop damage in 1990 than in 1975 even though fossil-fuel burning is projected to increase.

9340 **System for the experimental evaluation of the ecological effects of sulfur dioxide.** Lee, J.J.; Preston, E.M.; Lewis, R.A. (Corvallis Environmental Research Lab., OR). pp 49-53 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

The objectives of the EPA's Montana Coal-fired Power Plant Project are to characterize the impact of coal-fired power plant emissions on Northern Great Plains ecosystems and to develop a power plant siting strategy which incorporates ecological effects information. The air pollution field experiments described are designed to provide, in part, the data needed to develop predictive dose-response models. The specificity, thresholds, and temporal relationships of the effects of SO_2 on components of the grassland ecosystem are being studied. The Zonal Air Pollution Systems (ZAPS) employed in these experiments were designed to permit continuous SO_2 fumigation of minimally disturbed grassland plots duing an entire growing season. Each ZAPS group consists of 4 plots. Each plot receives a pre-selected median concentration of SO_2. Each gas delivery system consists of a network of 1" aluminum pipe set parallel to the ground with 1/32" gas release ports at 10' intervals. There are more than 250 sources per 1 1/4 acre plot. No location on the plots is more than 18' fom a port. Biological samples are collected to determine the effects of SO^2 fumigation upon biomass dynamics, plant and animal community structure, sulfur accumulation in grasses, pollination systems, and lichens. The exposure system behaves in a predictable manner. Different selected SO_2 distributions can be maintained in the study plots with desired relationships to Federal and State standards for SO_2. The system is a useful and practical tool for determining the effects of SO_2 on natural ecosystems.

9341 **Open-top chamber study to evaluate the effects of air pollution on soybean yield.** Kohut, R.J. (Ecology Consultants, Inc., Fort Collins, CO); Krupa, S.V.; Russo, F. pp 71-73 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Open-top chambers have been developed by researchers to evaluate the effects of chronic air pollution exposures on vegetation in the field. A study utilizing open-top chambers was conducted in Minnesota to evaluate the effects of ambient levels of ozone from the Minneapolis-St. Paul urban area and sulfur dioxide from a coal-fired power plant on soybean yield. The chambers allow plants to be grown under field conditions, but receiving treatments of either filtered or nonfiltered air. Three chambers were utilized for each treatment. Treated activated charcoal was employed to remove both ozone and sulfur dioxide from the filtered air chambers. Hodgson soybeans (Glycine max), a cultivar commonly grown in the study area, were planted in the chambers in May and harvested in September. The data collected at harvest were evaluated by analysis of variance to determine the effects of the air pollutants on yield. The analysis indicated that there were no significant differences in the number of plants, the number of pods per plant or the total number of pods in the treatments. There was, however, a significant reduction (24%) in the yield from the soybean plants in the nonfiltered treatment compared to the yield from the filtered air treatment. Foliar injury characteristic of ozone or sulfur dioxide was not observed on any of the plants in either treatment. The results of this study indicate that air quality can have a significant impact on soybean yield and that this yield reduction can occur without the development of visible foliar injury on the affected plants.

9342 Dimethylmercury: volatilization from plants. Gay, D.D. (Environmental Protection Agency, Las Vegas, NV); Fortmann, L.C.; Wirtz, K.O.; Frank, C.W. pp 187-191 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Dimethylmercury was the only organomercurial released from dwarf peas (Pisum sativum cv. Little Marvel) when the roots of the plants were exposed to mercuric chloride at a concentration of 0.1 μg/ml of solution or when the aerial portions of the plants were exposed to elemental mercury at a concentration of 7.6 ng/ml of air. Methylmercury and ethylmercury have been found in peas treated with inorganic mercury and/or elemental mercury, but neither of these compounds was released from the peas. Using a modified gas chromatography-microwave emission spectrometer which has the capability of routinely detecting 0.5 picograms of mercury, the dimethylmercury in air samples over mercury-treated peas was measured.

9343 Effects of cadmium pollution on plants and their toxicity to man. Dewit, A. (Belgian Military Force, Brussels, Belgium); Verbeken, R. pp 212-213 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

One of the major pathways of Cd uptake by man is through eating contaminated plants. Therefore the Cd uptake by water-cultured plants was studied followed by the experimental evaluation of Cd concentrations in soil-cultured plants and by plants growing surroundings of smelting works. The water-cultures showed a remarkable Cd uptake and revealed an active and passive uptake mechanism. The soil cultures showed Cd concentrations in the comestible parts of the pants, which seem to be normal for the plants but toxic to man. In all the cases the Cd content exceeds the acceptable daily intake as recommended by the WHO. The Cd concentration depends on the time between pollution and harvest. Most plants do not tolerate the metal pollution in the close vicinity of the smelter: only grasses do survive. The metal concentrations in the plants growing in a 2 mile area are extremely dangerous to men.

INVERTEBRATES

REFER ALSO TO CITATION(S) 8907, 9078, 9232

VERTEBRATES

REFER ALSO TO CITATION(S) 9205, 9270, 9290, 9366

9344 (COO—2792-4) **Molecular mechanisms of the epithelial transport of toxic metal ions, particularly mercury, cadmium, lead, arsenic, zinc, and copper. Progress report, January 1, 1979-December 31, 1979.** Wasserman, R.H. (Cornell Univ., Ithaca, NY (USA)). 1979. Contract EY-76-S-02-2792. 41p. Dep. NTIS, PC A03/MF A01.

The purpose of the present studies was to elucidate the mechanism of lead transport, and especially the particular similarities or dissimilarities between lead and calcium in this process. The absorption of these metals was determined in 3-week old White Leghorn cockerels, raised on a commercial diet or on a specified diet, using in vivo ligated loop procedure. The dose administered into the loop contained 0.5 μCi ^{203}Pb (and/or 0.1 μCi ^{47}Ca), and 0.01 mM lead acetate (and/or 1 mM $CaCl_2$) in 0.5 ml 0.15 M NaCl,pH 6.5. It was shown that lead is rapidly taken up by the mucosal tissue, and slowly transferred into the body, whereas less calcium is retained by the tissue and the transfer of calcium is many times as effective as that for lead. They appear to respond in a similar manner to a low calcium intake and vitamin D treatment. Certain differences were, however, observed in the absorption process. Increasing luminal stable lead concentration from 0.01 to 1.00 mM Pb, significantly reduced the percentage of radiolead absorbed, but did not affect the absorption of calcium. Also, vitamin D enhanced the transfer of plasma ^{47}Ca into the lumen but did not affect the transfer of plasma ^{203}Pb. Intravenous administration of 1,25$(OH)_2$CC to rachitic chicks enhanced calcium and lead absorption, but the maximal absorption of these metals occurred at slightly different times after administering this metabolite, and the effect on calcium outlasted that on lead, indicating that two different transport systems may be involved. It was concluded that lead is transported across the epithelial wall by a passive diffusion and this process is affected by vitamin D in a similar manner as this vitamin affects the diffusional component of calcium transport.

9345 (COO—4384-2) **Comparative evaluation of effects of ozonated and chlorinated thermal discharges on estuarine and freshwater organisms.** Meldrim, J.W.; Holmstrom, E.R.; Balog, G.E. (Ichthyological Associates, Inc., Ithaca, NY (USA)). 23 Jul 1979. Contract EE-77-C-02-4384. 102p. Dep. NTIS, PC A06/MF A01.

Portions of document are illegible.

Although limited, the results of tests evaluating the comparative effects of chlorinated and ozonated thermal discharges on mummichog and white perch indicate that the biological effects of ozonation are much less severe than those of chlorination. The data also show white perch to be more sensitive than mummichog to the tested biocides. The relative effects of ozonation and chlorination in the behavioral studies were similar to those observed in the toxicity studies. Cough rates were higher in chlorinated than in ozonated thermal discharges at similar test concentrations. Avoidance concentrations of white perch were less than those for mummichog and all determined avoidance concentrations were less than lethal levels. The biological effects of any oxidizing biocide on a given species, however, are usually site specific. The chlorine avoidance concentrations of white perch tested at Bergen averaged 0.04 mg/1 total chlorine but averaged 0.06 mg/1 total chlorine when tested in Delaware estuarine waters. Although the amount of data obtained at Bergen is not large, it is indicative of the comparative biological effects in despoiled waters. Assuming such waters will be improved, however, concern then arises over the comparative effects of chlorination and ozonation in waters which support large populations of aquatic organisms. (ERB)

9346 Skin carcinogenicity of synthetic and natural petroleums. Holland, J.M.; Rahn, R.O.; Smith, L.H.; Clark, B.R.; Chang, S.S.; Stephens, T.J. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Occup. Med.;* **21**: No. 9, 614-618(Sep 1979).

In a series of three separate experiments mice were exposed to various concentrations of fossil liquids obtained from coal, oil shale or natural petroleum. All materials were capable of inducing squamous cell carcinoma, but potency differed substantially. Skin carcinogenicity was markedly greater for both coal or oil shale liquids than for natural petroleums. None of the syncrudes approached the skin carcinogenicity of a pure reference carcinogen, benzo(a)pyrene (BP). It is unlikely that determination of the concentration of an active compound in material applied to the test animal will allow meaningful comparison among the diverse agents of interest to the synthetic fuels industry. To better establish the relationship between actual tissue dose and surface concentration the authors are investigating various in vitro and biochemical measures of hydrocarbon-skin interaction to determine which, if any, could serve as a more definitive measure of surface dose. Results, using BP as a marker carcinogenic hydrocarbon, suggest that carcinogenic crudes inhibit both BP metabolism in skin organ culture and the interaction of BP adducts with epidermal DNA, in vivo.

9347 (ORNL—5424) **Tobacco smoke inhalation bioassay chemistry.** Guerin, M.R.; Stokely, J.R.; Higgins, C.E. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 171p. Dep. NTIS, PC A08/MF A01.

The significant findings and analytical developments of an approximately three-year inhalation bioassay chemistry research program are presented. The purpose of the program was to define the characteristics of the Walton Horizontal Smoking Machine as an inhalation exposure device for mice. The study was sufficiently detailed so as to assess the general concept of rodent inhalation exposure to standing smoke. Both monitoring concepts and analytical methods and instrumentation were developed to do the task. Results are presented in thirteen sections, each of which was abstracted and indexed individually for EDB/ERA. (JGB)

9348 (ORNL—5424, pp 1-17) **Description and characteristics of the Walton Horizontal Inhalation Exposure Smoking Machine.** Stokely, J.R. (Oak Ridge National Lab., TN); Moneyhun, J.H.; Guerin, M.R.; Florant, L.; Greenspan, J. Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

An improved inhalation exposure device, the Walton Horizontal Smoking Machine, was devised for exposure of small laboratory animals. The objective was to mechanically produce smoke closely representing that produced by humans. Machine refinements and the evaluation of machine operation are described. Smoke of the proper, predicted dilution is provided; its composition agrees with that of smoke produced by the Phipps and Bird analytical smoking device except for having a slightly higher nicotine concentration.

9349 (ORNL—5424, pp 19-33) **Process and Instruments Corporation automatic Smoke Exposure Machine: SEM II.** Moneyhun, J.H. (Oak Ridge National Lab., TN); Stokely, J.R.; Florant, L. Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

An automatic Smoke Exposure Machine (SEM II) was designed and constructed by Process and Instruments Corporation to generate a continuous stream of fresh cigarette smoke for small-rodent inhalation experiments. Some of the problems associated with intermittent smoking systems, aging of smoke, depletion of the aerosol by animals, and limitations of the number of animals simultaneously exposed are circumvented. The SEM II system is described, its operating principles and characteristics are explained and chemical characterization of the smoke delivered, as compared to an analytical system.

9350 (ORNL—5424, pp 35-46) **Animal containment vessels for nose-only inhalation bioassay exposure to tobacco smoke.** Guerin, M.R.; Caton, J.E.; Dalbey, W.E. (Oak Ridge National Lab., TN). Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

Whole body exposure compromises the results of inhalation bioassay testing because smoke constituents can be ingested by means additional to respiration. Nose-only exposure eliminates these extraneous routes of administration, but the restraint required produces stress which may influence dosimetry, longevity, and the results of the bioassay. Several animal containment mechanisms were tested on hamsters, rats, or mice exposed to cigarette smoke from the Walton Horizontal Smoking Machine, the Maddox/ORNL smoke exposure system, or the Process and Instruments Smoke Exposure Machine. Retained dose depends on containment method. Stress from confinement in restraining tubes was manifested by weight loss. Neck-only restraint has several advantages over previously used methods of containment.

9351 (ORNL—5424, pp 47-61) **Sensor for detection of tobacco smoke particulate matter in inhalation exposure systems.** Gayle, T.M.; Higgins, C.E.; Stokely, J.R. (Oak Ridge National Lab., TN). Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

A need for a simple, rapid, non-destructive method of measuring the quantity of smoke to which animals are exposed has led to the development of a method based on light-scattering. A light-emitting diode and phototransistor array has been interfaced to both static and dynamic exposure systems. The diode element emits light into the aerosol, and light reflected by the smoke particles is detected by the phototransistor. Light-sensor readout is directly proportional to smoke concentration and is independent of natural tobacco smoke composition. The device is useful both for evaluating smoke inhalation systems and for documenting exposures.

9352 (ORNL—5424, pp 63-74) **Cigarette smoke monitoring device for continuous animal exposure systems.** Gayle, T.M.; Higgins, C.E.; Stokely, J.R. (Oak Ridge National Lab., TN). Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

The safety of animals undergoing inhalation exposure to smoke requires that the smoke concentration stays within acceptable limits. A monitor was developed both for animal protection and for recording smoke concentration and exposure time. Total particulate matter is measured by a light sensor and carbon monoxide by non-dispersive infrared analysis. As used with the Process and Instruments Corporation's Smoke Exposure Machine (SEM II), the monitor's signals activate an appropriate safety apparatus to protect animals from overexposure. Results are presented from operational evaluation over several months.

9353 (ORNL—5424, pp 75-84) **Method for the sampling and determination of nicotine and methane as indicators of tobacco smoke concentration in inhalation exposure systems.** Yeatts, L.B.; Moneyhun, J.H.; Stokely, J.R. (Oak Ridge National Lab., TN). Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

Controlling the amount of exposure to smoke that animals receive in an inhalation exposure system requires that the smoke concentration be accurately known. A general method was developed to determine tobacco smoke concentration in such a system by sampling and analyzing both gas and particulate phases. Methane and nicotine, gas and particulate phase components respectively, serve as indicators of smoke concentration. Sampling smoke with a dual syringe, withdrawal-infusion pump and analyzing by gas chromatography permits determination of smoke concentration on either an individual puff or composite-of-all-puffs basis. Results are more accurate when the composite sample is used. Both indicators give smoke dilutions close to calculated dilutions.

9354 (ORNL—5424, pp 85-95) **Organic gas phase composition of contained smoke aerosols used for inhalation testing.** Higgins, C.E.; Stokely, J.R. (Oak Ridge National Lab., TN). Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

The organic gas-phase composition of smoke offered animals by the Walton Horizontal Smoking Machine for inhalation exposure is compared to that of smoke produced under standard conditions to determine the relevance of the exposure. Cryothermal trapping and high-resolution capillary column gas chromatography are used to investigate the effects of containment on the gas phase of cigarette smoke. There are no significant differences in smoke aged 5 to 25 sec in the Walton exposure chamber. Mice reduce the concentration of gas phase constitutents, with an indication that high-boiling constituents are retained or otherwise influenced preferentially to low boilers. The organic gas-phase constituent composition of exposure chamber smoke is the same as that of standard whole smoke. However, constituents which exist both as gas phase and particulate matter distribute to a greater degree into the gas phase in chamber smoke.

9355 (ORNL—5424, pp 97-102) **Determination of nitric oxide in the exposure chamber of the Walton Horizontal Smoking Machine.** Honaker, C.B.; Horton, A.D.; Jenkins, R.A. (Oak Ridge National Lab., TN). Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

Chromatographic separation of nitric oxide from atmospheric oxygen has permitted the quantitative determination of NO in animal inhalation exposure chambers. There appears to be little cigarette-to-cigarette variation in total NO delivery. Measurements inside the Walton exposure chamber without animals indicate that NO in 9% cigarette smoke has a half-life of ~ 13 minutes. Decreases of NO concentrations in the presence of animals suggest that the average retained dose of NO may be as high as high as 7 μg NO per animal per cigarette.

9356 (ORNL—5424, pp 103-118) **Determination of particle size in tobacco smoke inhalation exposure devices using methylcyanoacrylate fixation and scanning microscopy.** Holmberg, R.W. (Oak Ridge National Lab., TN). Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

A method for measuring particle size distributions in cigarette tobacco smoke is discussed. Smoke particles are fixed in the gas phase by contacting them with methyl-2-cyanoacrylate vapors and are collected on Nuclepore filters for scanning electron microscope (SEM) examination. Diameters are determined from SEM photographs using a graphic digitizer. Distribution characteristics are calculated from stored diameter values using minicomputer-based programs. A simple portable sampling technique suitable for use under bioassay exposure conditions is described and examined for possible bias. Size distributions typical of exposure conditions are reported.

9357 (ORNL—5424, pp 119-129) **Method for the determination of tobacco smoke inhalation dosimetry using carbon-14 labeled dotriacontane.** Caton, J.E. Jr. (Oak Ridge National Lab., TN). Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

A facility was established to provide analytical support of investigations into the influence of exposure conditions on tobacco smoke inhalation dosimetry using mice. A method for more rapid and accurate analyses of tissues for carbon-14 and for processing the large quantity of data generated was needed to meet support requirements. Rigorous controls were included in the dosimetric method to ensure reliability and to allow comparisons between exposure parameters.

9358 (ORNL—5424, pp 131-135) **Influence of smoking configuration on particulate delivery.** Stokely, J.R. (Oak Ridge National Lab., TN); Guerin, M.R.; Bayne, C.K. Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

A single port smoking machine and the Walton Horizontal Smoking Machine were used to evaluate the influence of smoking configuration on deliveries of tar and nicotine. Results are compared with standard deliveries as determined using a Phipps and Bird analytical smoking machine. The cigarettes delivered the same quantities of tar and nicotine in either a vertical or horizontal position. Free smoking results in an increased delivery of tar and, especially, nicotine as compared to restrictive smoking. The Walton Horizontal Smoking Machine produces the same delivery of tar and nicotine whether it is operated as a reverse smoker or the smoking mechanism is modified to provide draw puffing.

9359 (ORNL—5424, pp 137-147) **Carbon monoxide and carbon dioxide concentrations in smoke as a function of inhalation exposure using mice.** Stokely, J.R.; Guerin, M.R.; Pair, D.D. (Oak Ridge National Lab., TN). Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

The concentrations of carbon monoxide and carbon dioxide in the inhalation chamber of the Walton Horizontal Smoking Machine while exposing 20 C57 black mice were determined as a function of exposure history. Carbon monoxide concentrations were in the expected range, and carbon dioxide contributions to the inhalation atmosphere by animal respiration did not exceed 0.5% (v/v). Experienced animals each depleted approximately 1% of the available carbon monoxide from a 10% (v/v) smoke from the Kentucky 2AI cigarette. Carbon dioxide evolution monitoring suggests that the mice quickly learn to avoid smoke inhalation. The avoidance mechanism reaches its limit after two weeks of smoke exposure.

9360 (ORNL—5424, pp 149-155) **Monitoring hydrogen as a measure of smoke concentration.** Gayle, T.M.; Higgins, C.E.; Moneyhun, J.H.; Stokely, J.R. (Oak Ridge National Lab., TN). Oct 1979.

In Tobacco smoke inhalation bioassay chemistry.

Thermal conductivity of the gas phase of tobacco smoke may be monitored to provide a continuous measure of smoke concentration. The response is due almost solely to the presence of hydrogen when the monitor is fitted with a water and carbon dioxide scrubber system. The device is useful as a monitor of smoke concentration in inhalation exposure systems.

9361 Tissue distribution of inhaled mercury vapor in acatalasemic mice. Sugata, Y.; Halbach, S.; Allen, J.; Clarkson, T.W. (Univ. of Rochester, NY). *J. Environ. Sci. Health, Part C;* **13**: No. 2, 97-106(1979).

Substantial differences were observed in the pattern of tissue deposition in normal versus acatalasemic mice after inhalation of radioactive mercury vapor. Liver deposition was approximately double and lung deposition approximately one-half the corresponding deposition in normal animals. These results lend further support to the idea that the hydrogen-peroxide catalase peroxidative pathway plays a role in the metabolism of inhaled mercury vapor.

9362 Behavioral effects of carbon monoxide on animals and man. Laties, V.G.; Merigan, W.H. (Univ. of Rochester School of Medicine and Dentistry, NY). *Annu. Rev. Pharmacol. Toxicol.;* **19**: 357-392(1979).

The literature on the behavioral effects of CO includes an enormous range and variety of experiments. Unfortunately, the great majority of these reports isolated observations rather than systematic extensions of previous findings. For this reason, the conclusions reached about CO effects as a function of subject, task, and exposure parameters are quite tentative. Future experimental work, rather than simply adding new observations, should emphasize parametric investigations of those variables that the currently available literature suggest are the most crucial contributors to the behavioral toxicity of CO.

9363 Responses of prairie deer mice to a field SO_2 gradient. Chilgren, J.D. (Environmental Protection Agency, Corvallis, OR). pp 61-65 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

A capture-mark-release study of deer mice (Pero-myscus maniculatus) was conducted on two 10-acre grassland areas (Zonal Air Pollution Systems or ZAPS) at monthly intervals from April to September 1976. Both areas were subdivided into four in-line experimental plots, with three smaller plots as buffer zones. Each of four experimental plots was fumigated at a median SO_2 concentration of nearly O (control), 2.2 (low), 3.9 (medium) and 6.5 (high) pphM, respectively. Three functional groups of mice were recognized: resident adults and juveniles (group 1); transient adults and juveniles (group 2); and resident and transient adults (group 3). Temporal displacement and numerical replacement of group 1 was directed toward areas of lower SO_2 concentration. Members of group 2, especially juveniles, were trapped more frequently on the control and low SO_2 plots on ZAPS 2, but transient juveniles were virtually absent from ZAPS 1. Recruitment of group 3 onto the control plots at both ZAPS occurred more rapidly than onto other plots in late summer. Throughout most of the trapping period, the number of occupied traps on all fumigated plots decreased relative to control plots on both ZAPS, and remained relatively higher on control plots from mid-season to the experiment's conclusion.

9364 Biochemical methods for assessing the health effects of environmental pollutants. Mustafa, M.G. (Univ. of Califonia, Los Angeles); Lee, S.D. pp 519-522 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Biochemical alterations, which are thought to be the early events of pollutant interaction with the target organs, perhaps represent relatively more sensitive indices of pollutant damage than the conventional pathophysiologic changes. The biological effects of ozone, nitrogen dioxide, and oxides of sulfur were studied in terms of biochemical changes in the lung after exposure of animals to one of these pollutants. To assess the pollutant effects, a series of biochemical parameters have been examined, and these include glucose metabolism, oxidative and energy metabolism, protein and nucleic acid metabolism, and analyses of chemical/metabolic products. The biochemical studies were carried out at the level of whole animals, organs, tissues, cells, and subcellular organelles. The studies have enabled the defining of the dose-response relationship, threshold limit value, relative short-term and long-term effects, and reversible or irreversible nature of pollutant effects. The biochemical data have been useful in correlating morphologic changes in the lung.

9365 Lung organ cultures: a useful model for investigating the biochemical and toxicological effects of environmental contaminants. Hussain, M.Z. (Univ. of California, San Francisco); Belton, J.C.; Bhatnagar, R.S. pp 532-536 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Diseases of the lung are becoming increasingly prevalant as the variety and quantity of contaminating agents in the atmosphere increase. It is therefore important to devise experimental procedures which would permit the evaluation of the effects of selected agents on the lungs. Most models currently used in such investigations are based on animal studies. Use of intact animals is not satisfactory because of high cost and often unreliable responses. It is time-consuming even in the simplest situation. Models based on isolated cell cultures do not mimic the response of the whole lung since it lacks cell-cell and cell matrix interactions which may be important for a composite response of the tissue systems involved in the disease process. An in vitro lung organ culture system that circumvents most of these problems is described. In this model, newborn rat lungs are cultured on commercially available nutrient medium. The lungs in organ culture demonstrate normal biochemical growth behavior for several days. When exposed to known environmental toxins, either gaseous or dissolved in the medium, these cultures rapidly develop biochemical as well as morphological symptoms of disease similar to those observed in lungs of animals exposed to the same agents. The response of lung organ cultures to toxins Cd and Hg is rapid and highly reproducible. Therefore this procedure may permit the examination of the course of lung injury by environmental agents.

MAN

REFER ALSO TO CITATION(S) 9069, 9125, 9126, 9127, 9320, 9336, 9362

9366 (EPA/600/9—78-022, pp 51-69) **Effects of H_2SO_4 on men and H_2SO_4 and O_3 on laboratory animals.** Gardner, D.E.; Hazucha, M.; Knelson, J.H.; Miller, F. (Environmental Protection Agency, Triangle Research Park, NC). Oct 1978.

From 3. national conference on the interagency R and D program; Washington, DC, USA (1 Jun 1978).

Eighteen healthy, young, nonsmoking male volunteers were divided into three groups, each group being exposed to various concentrations of H_2SO_4. Contrary to expectations, data indicated that those subjected to low concentrations of H_2SO_4 showed greater changes in various lung function parameters than subjects exposed to high concentrations. Experiments were conducted with hamsters, exposing them to H_2SO_4 alone, ozone alone, then H_2SO_4 and ozone. Neither pollutant alone caused a significant increase in mortality, as compared with clean air controls. However, when exposure to the oxidant gas (ozone) immediately preceded that of the acid, there was a statistically significant increase ($p < 0.05$) in respiratory infections in the treated group over controls. (JGB)

9367 Interference with steps in collagen synthesis: a test for pulmonary toxicity of environmental agents. Bhatnagar, R.S.; Hussain, M.Z. (Univ. of California, San Francisco). pp 527-531 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Collagen plays a major role in lung structure and function. Lung collagen is known to turn over at a high rate. Collagen synthesis involves several post-translational enzymatic steps. Interference with any of these steps would lead to altered collagen content and physico-chemical properties resulting in pulmonary dysfunction. The reparative response to this biochemical injury may result either in further depletion (emphysema) or excess deposition (fibrosis) of connective tissue components. Studies show that a variety of agents toxic to lungs interfere with one or more steps in the synthesis of collagen. These include Cd, Hg, Pd, and Pt. Oxidants and superoxide generating systems induce the synthesis of collagen and of enzymes involved in its processing. Because interference with normal collagen synthesis may be a crucial part of environment-tissue interaction leading to pulmonary dysfunction examination of the interaction of an agent with key enzymes in collagen synthesis may provide a convenient procedure for evaluating their potential hazards.

9368 Prenatal methylmercury poisoning: clinical observations over five years. Amin-Zaki, L. (Univ. of Baghdad, Iraq); Majeed, M.A.; Elhassani, S.B.; Clarkson, T.W.; Greenwood, M.R.; Doherty, R.A. *Am. J. Dis. Child.;* **133**: 172-177(Feb 1979).

Thirty-two infants prenatally exposed to methylmercury and their mothers were examined over a five-year period after the Iraqi methylmercury epidemic. Severity of poisoning in mothers was related to the peak mercury concentration in their hair and in the infants to the maximum concentration in maternal hair during pregnancy. In nine cases of cerebral palsy, methylmercury exposure occurred only during the last trimester. All infants except three (two were orphaned soon after birth and one was bottle-fed) were exposed postnatally via suckling. Whereas the mother's symptoms usually improved, the damage to the fetal nervous system appears to be permanent. Milder cases previously not identified in other studies are reported. The syndrome consists of varying degrees of developmental retardation in addition to exaggerated tendon reflexes and the pathologic extensor plantar reflex (minimal brain damage syndrome).

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 8447, 9303, 9317

9369 (DOE/ET/6010—1) **Initial psychoacoustic experiments on the human response to transmission line audible noise.** Molino, J.A.; Zerdy, G.A.; Lerner, N.D.; Harwood, D.L.; Tremaine, S.G. (National Engineering Lab. (NBS), Washington, DC (USA)). 1978. Contract EA-77-A-01-6010. 82p. Dep. NTIS, PC A05/MF A01.

A project is underway to investigate human response to transmission line audible noise. This project is developing a psychoacoustic data-base to determine the extent to which present measurement scales and human response criteria are appropriate for evaluating the environmental impact of transmission line audible noise, and to suggest different scales and criteria if necessary. A realistic listening room was used for psychoacoustic experiments in which a listener was given choices between various acoustic environments, including corona sounds, while reading a book. In another experiment groups of participants rated various sounds for their annoyance level while watching television programs. Results indicate that despite its relatively low sound level, corona noise is equally aversive to certain other environmental sounds that are 8 dB higher in sound pressure level. All of the common frequency weighting scales underestimate the aversiveness of corona noise relative to other environmental sounds. From a limited sample of comparison sounds, corona noise was found to be roughly equal in aversiveness to the noise from a room air conditioner. Knowledge of the source of the noise did not affect the relative aversiveness of corona noise as presented in the laboratory. The high-frequency hissing and crackling components of corona noise are more aversive than the low-frequency humming and buzzing components. There are distinctly different kinds of corona noise which differ both in frequency spectrum and relative aversiveness. Thus, in order to assess environmental impact, long-term sampling of corona noise from different lines may be needed. Similar results were obtained from experiments involving reading and television viewing as participant activities, indicating consistent and generalizable findings. (JGB)

9370 (JPRS—73777) **Translations on USSR science and technology. Biomedical and behavioral sciences, No. 82. Effects of nonionizing electromagnetic radiation.** 28 Jun 1979. Translation of various articles. 98p. NTIS.

Separate abstracts were prepared for 5 of the 14 papers presented in this issue of the translations. Five of the remaining nine papers discuss the application of low frequency and ultrahigh frequency magnetic waves in the therapy of rheumatic and spastic conditions. The effects of radiowaves on the neuro-humoral system in rats, of microwaves on the posterior hypothalamus, of ionizing radiation on laying hens, and of electromagnetic fields (arc welding) on welders are discussed in the remaining 4 papers. (ERB)

9371 (JPRS—73777, pp 1-7) **Effects of magnetism on thrombocyte coagulation.** Rusyaev, V.F. 28 Jun 1979. Translated from Probl. Gematol. Pereliv. Krovi; No. 2, 19-23(1979). NTIS.

In Translations on USSR science and technology. Biomedical and behavioral sciences, No. 82.

The initial stage of thromboembolisms involves the aggregation of thrombocytes, with subsequent release of blood clotting factors from them. In connection with this, the present study investigated aggregative, coagulative, and certain biological indicators of dog thrombocytes subjected to the action of a constant magnetic field (CMF) of 1,200 oersted intensity. The results of these studies showed that a CMF changes the biological properties of thrombocytes and stimulates their aggregation. Our observations give grounds for proposing that the CMF modifies the membrane so that its structural components can be released into the external medium. It is quite possible that the phospholipids (or phospholipoproteids) constitute just such components. Undoubtedly, fragmentation of the thrombocytic membrane and the release of its elements into the external medium will increase the thromboplastic activity, as is confirmed by the findings of our experiments. Reduction of the electrokinetic potential as a result of the destruction of the membrane reduces the force of electrostatic repulsion and promotes cell aggregation. Thus, the most likely mechanism of CMF influence on thrombocytes is the disruption of the cell membranes accompanied by the release of phosphlipid components into the external medium. The result of this is a reduction in the number of ionized groups on the surface of the cells and, consequently, the surface charge, an increase in aggregation activity, suppression of active transport, and an increase in the permeability of the membrane with respect to endogenous inductors of aggregation and coagulologically active components. (ERB)

9372 (JPRS—73777, pp 8-12) **Pathogenesis of insulin deficiency on exposure to commercial-frequency alternating magnetic field.** Kolesova, N.I.; Voloshina, E.I.; Udintsev, N.A. 28 Jun 1979. Translated from Patol. Fiziol. Eksp. Ter.; No. 6, 71-73(1978). NTIS.

In Translations on USSR science and technology. Biomedical and behavioral sciences, No. 82.

From the data on the in vivo studies it follows that single exposure to AMF substantially elevates the level of total insulin activity, which normalizes by the seventh day, and then rises again. The in vitro experiments showed that the level of glucose uptake from the incubation medium by the fatty tissue of the experimental animals is reliably higher than the data obtained in the control, while the uptake of glucose by muscle tissue proved to be somewhat lower. In the experiment with the experimental animal tissues, adding insulin led to a substantial increase in the glucose uptake by the fatty tissue. The insulin addition also stimulated the glucose uptake by the muscle tissue, although it did not reach the level noted for the intact animals. Therefore, the AMF has a more pronounced effect on glucose uptake by fatty tissue than for muscle tissue, evidently by modifying the reactivity of the tissues toward insulin. After multiple exposure to the AMF, a reduction was noted in the level not only of free insulin, but also of total insulin activity, that is, symptoms of absolute insulin insufficiency developed. Thus, after single exposure to the AMF substantial increase in total insulin activity is observed, which is evidently an important component of the adaptive reaction of the organism, promoting the compensation of the neuroendocrinal and metabolic shifts noted during this period. An increase in the duration of exposure to AMF leads to more profound changes in the function of the islets of Langerhans: there is a decrease in the content of not only free insulin, but also the total insulin activity. These changes evidently are closely associated with well-defined disturbances in the carbohydrate-energy metabolism. (ERB)

9373 (JPRS—73777, pp 13-18) **Effect of a uhf electric field on spermatogenesis.** Danilova, I.N.; Skurikhina, L.A.; Skuratovich, A.A.; Ayvazyan, A.A. 28 Jun 1979. Translated from Vopr. Kurortol., Fizioter. Lech. Fiz. Kul't.; No. 2, 16-19(1979). NTIS.

In Translations on USSR science and technology. Biomedical and behavioral sciences, No. 82.

A number of experimental and a few clinical works have been devoted to research on the effect a uhf electric field has on fertilization, but the results are contradictory and it is difficult to generalize the obtained data, especially due to the lack of accurate dosimetry. Studying the effect of a uhf electric field on spermatogenesis, the following were analyzed: (1) clinical catamnestic data on patients treated with a uhf electric field; (2) the ejaculate of these patients and the activity and survival of spermatozoids outside the body; and (3) the histological pattern of rabbit testicular and deferent duct tissues following exposure of the scrotum to a uhf electric field. Catamnestic data obtained by investigation of the fertilizing function as well as microscopic analysis of the ejaculate of patients failed to confirm that a uhf electric field has an injurious influence on spermatogenesis when employed as indicated above. Activation of spermatogenesis in comparison with control rabbits was noted the day following exposure to a 30 watt uhf electric field with a gap of 1.5 to 2 cm. No histological differences from control were found in the testes and epididymuses of experimental rabbits 5 days after the last treatment; there was no significant change in the state of spermatogenesis of experimental rabbits in comparison with control rabbits 10 and 30 days later. Thus dynamic experimental investigation of the histological pattern of the testes and epididymuses showed that a uhf electric field does not cause significant changes in the intensity and nature of spermatogenesis in rabbits. (ERB)

9374 (JPRS—73777, pp 63-68) **Effect of magnetic field on the electrical conductivity of chicken egg proteins and yolk during early stages of incubation.** Borodaykevich, D.T.; Khananaev, L.I. 28 Jun 1979. Translated from Biol. Nauki; No. 4, 34-38(1979). NTIS.

In Translations on USSR science and technology. Biomedical and behavioral sciences, No. 82.

Investigations were conducted on the dynamics of electrical conductivity of the proteins and yolk of chicken eggs exposed to 50, 100, or 200 oe static (SMF), alternating (AMF), or pulsating (PMF) magnetic fields prior to incubation. Exposure to 100 and 200 oe AMF or PMF led to an increase in conductivity during the early stages of incubation, while exposure to SMF resulted in a decrease. The data suggest that preincubation treatment of chicken eggs by various MFs has different consequences: during early stages of incubation PMF and AMF increase conductivity, while SMF decreases conductivity in comparison with control values. It may be assumed that PMF and AMF enhance tissue ion metabolism, as indicated by the increase in the conductivities of chicken egg proteins and yolk. The decrease in conductivity seen with SMF is apparently due to inhibition of ion metabolism. (ERB)

9375 (JPRS—73777, pp 70-75) **Change in the processes of transamination in the tissues of the liver and small intestine of rats under the action of high frequency electromagnetic fields.** Faitel'berg-Blank, V.R.; Lekhan, I.G. 28 Jun 1979. Translated from Ukr. Biokhim. Zh.; No. 1, 14-17(1979). NTIS.

In Translations on USSR science and technology. Biomedical and behavioral sciences, No. 82.

Change in the enzymatic activity of transamination was studied in the liver and mucosa of the small intestine of rats under the influence of electromagnetic waves of the radio frequency range. It was demonstrated that 20-minute exposure to diathermy at an anode current of 160 ma and to microwaves at an intensity of 30 mw/cm² is accompanied by depression of aminotransferase activity in the tissue studied. With high frequency irradiation at an intensity of 12 mw/cm² and an exposure of 20 min, aminotransferase activity in the liver, the mucosa of the small intestine, and serum increases.

9376 Isolation of uv-sensitive clones from a haploid frog cell line. Rosenstein, B; Ohlsson-Wilhelm, B.M. (Univ. of Rochester, NY). *Somatic Cell Genet.;* 5: No. 1, 117-128(1979).

An isolation procedure has been developed which yielded five clones of haploid frog cells which are sensitive to ultraviolet light. This procedure employed a conventional mutagenesis, followed by time for phenotypic expression and then an enrichment for uv-sensitive mutants. The enrichment relies upon the uptake of bromodeoxyuridine (BrdU) by repairing cells following uv-induced damage, rendering repair-proficient cells differentially sensitive to photolysis by black light. The photolysis is potentiated by use of the bisbenzimidazole dye Hoechst 33258. The enriched population was screened for radiation-sensitive isolates resulting in 5 sensitives from 96 tested. No mutants were obtained from 300 isolates tested from a population which had not undergone enrichment.

9377 Ambient measurements of asbestos in the vicinity of asbestos sources. Ruch, R.B. Jr.; Serper, A. (Equitable Environmental Health, Inc., Woodbury, NY). pp 867-870 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

Atmospheric measurements of ambient asbestos levels were performed in the vicinity of inactive refuse piles once used for the disposal of asbestos wastes. The field monitoring program was designed to assess the degree of stabilization of the pile as well as the potential level of exposure to the residents in the local community. The general sampling methodology, filter analysis procedures, and the results of this field monitoring program are described. The sampling program was divided into two phases. The initial phase included performance of a preliminary survey designed to collect filter samples in order to determine the optimum dust-loading conditions for each type of sampler. During the second phase, an extensive monitoring network consisting of 13 air samplers and one portable wind system was operated at peselected locations in an area adjacent to the pile. Sampling was conducted during a 3-week period in November 1976 and during a 3-day period in July 1977. Based on previous established criteria for filter selection, over 70 air filters were examined by electron microscopy to determine the ambient asbestos fiber concentrations. Measurable asbestos levels were observed on only 8 filters. The results of the filter analysis are presented with respect to existing meteorological conditions, the physical state of pile, and the activities of other potential sources. Based on these results, it appears that this pile has sufficiently stabilized so that the level of exposure of the nearby community to airbone asbestos emissions from the pile is extremely low.

9378 Monitored asbestos concentrations indoors. Bruckman, L. (Connecticut Dept. of Environmental Protection, Hartford). pp 871-875 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

In order to define the magnitude of the hazard posed by the application of asbestos-containing surface coatings to the inside structural framework of schools and other public buildings and the subsequent release of asbestos into the indoor air environment, an air asbestos survey was conducted in the boy's swimming pool located in the University of Connecticut's Field House. The ceiling covering this pools was sprayed with an asbestos-containing insulating compound in 1955 and then re-sprayed some 10 years later. However, chunks of this asbestos-containing surface coating have been falling from this ceiling from some 2 years. Airborne asbestos levels at the pool were found to be well below (i.e., < 1 ng/m³) asbestos ambient air quality standard.

9379 Growth retardation in Chinese hamster V-79 cells exposed to 1 MHz ultrasound. Kaufman, G.E.; Miller, M.W. (Univ. of Rochester, NY). *Ultrasound Med. Biol.;* 4: 139-144(1978).

Asynchronous Chinese hamster V-79 cells were exposed in suspension to continuous wave 1 MHz ultrasound for 1 min at an axial intensity of 2.5 W/cm², then allowed to grow in monolayer culture. There was little if any growth, as determined by changes in the number of attached cells, for 24 hr after sonication, then a return to normal growth approximately 36 hr after sonication. The lack of growth during the first 24 hr appears to be due to an approximate balance between proliferation of viable cells and loss of non-viable cells into the medium.

HEALTH AND SAFETY

9380 (CONF-791203—6) Once upon a time (training for emergency situations). Olsen, W.C. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 6p. Dep. NTIS, PC A02/MF A01.

From Health Physics Society meeting; Honolulu, HI, USA (10 Dec 1979).

Taking the pretend out of the emergency is discussed in this manual on emergency response training. The following suggestions are made: (1) plan credible emergency situations, (2) select plausible locations, (3) write scenarios, (4) tailor situations to locations, (5) involve other organizations, (6) make injuries look realistic, and (7) let employees take part. (DC)

9381 (DOE/EY/22874—57) Inference about population attributable risk from cross-sectional studies. Fleiss, J.L. (Columbia Univ., New York (USA). School of Public Health). 26 Mar 1979. Contract EY-76-S-02-2874. 4p. Dep. NTIS, PC A02/MF A01.

The population attributable risk (PAR) is defined as the fraction of all cases of a disease in a population due to exposure to a given risk factor. The data collected in cross-sectional surveys are used to test a formula of standard error of PAR from which a 95% confidence interval for PAR may be deduced.

9382 (ORNL—5543) Industrial safety and applied health physics. Annual report for 1978. Auxier, J.A. (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 104p. Dep. NTIS, PC A06/MF A01.

There were no external or internal exposures to personnel which exceeded the standards for radiation protection as defined in DOE Manual Chapter 0524. Only 39 employees received whole body dose equivalents of one rem or greater. The highest whole body dose equivalent to an employee was 3.3 rem. The highest internal exposure was less than 25% of a maximum permissible dose for any calendar quarter. During 1978, 23 portable instruments were added to the inventory and 228 retired. The total number in service on January 1, 1979, was 1023. There were no releases of gaseous waste or liquid radioactive waste from the laboratory which were of a level that required an incident report to DOE. The average background level at the PAM stations during 1978 was 9.3 μR/hr, or 81 mR/yr. Soil samples were collected at all perimeter and remote monitoring stations and analyzed for eleven radionuclides including plutonium and uranium. Grass samples were collected and analyzed for twelve radionuclides including plutonium and uranium. During 1978, the Radiation and Safety Surveys personnel continued to assist the operating groups in keeping contamination, air concentrations, and personnel exposure levels below the established maximum permissible levels. Fourteen radiation incidents involving radioactive materials were recorded during 1978. Of the 582,000 articles of wearing apparel and 192,000 articles, such as mops, laundry bags, towels, etc., monitored during 1978 about four percent were found to be contaminated. Three lost workday cases occurred at ORNL in 1978, a frequency rate of 0.07. The Serious Injury frequency rate for 1978 was 1.40, as based on the new OSHA system for recording injuries and illness (RII). A total of 55 days were lost or charged for the three lost workday cases in 1978.

9383 Analysis of lead level measurements obtained in a survey of dwelling units in Pittsburgh, Pennsylvania. Billick, I.H.; Hall, W.G.; Shier, D.R. pp 810-813 of Fourth joint conference on sensing of environmental pollutants. Washington, DC; American Chemical Society (1978).

From 4. joint conference on sensing of environmental pollutants; New Orleans, LA, USA (6 Nov 1977).

This paper presents statistical analyses carried out using lead paint levels from approximately 3300 dwelling units, randomly selected from the city of Pittsburgh, Pennsylvania. The primary purpose of the survey was to assess (using a detailed series of lead level measurements) the extent, magnitude and distribution of lead-based paint within the dwelling units. In addition, measurements of lead levels were recorded for exterior surfaces of some of the dwelling units. The lead level measurements (in mg Pb/cm²) were obtained using a portable x-ray fluorescence lead detector. Measurements typically were taken from walls, ceilings, windows, doors and baseboards in all accessible rooms of the dwelling unit. Statistical analyses of the x-ray fluorescence measurements confirmed and quantified certain expected relations: namely, that older dwelling units exhibit considerably greater lead levels than newer housing units and that exterior surfaces show higher levels than corresponding interior surfaces. In addition, the variation of lead levels by occupancy class, room type, surface type, and surface condition were analyzed. The

relations between such variables and observed lead levels can prove useful in focusing on which dwelling unit types (and at which locations in dwelling units) excessive lead levels are likely to be found.

9384 **Kepone: a literature summary.** Huff, J.E.; Gerstner, H.B. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Environ. Pathol. Toxicol.;* **1**: 377-395(1978).

This overview provides a narrative survey of the reference literature on Kepone. The circumstances surrounding the Hopewell incident have increased the awareness and vigilance of state and federal agencies regarding human and environmental exposure to toxic chemicals. Highlights of this overview include history, nomenclature, uses, toxicology, environmental aspects, epidemiology, and conclusions. A chronologic history of Kepone is detailed in the Appendix.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 8049, 8132, 8158, 9398

9385 **Assessment of Landsat filters for rock type discrimination, based on intrinsic information in laboratory spectra.** Hunt, G.R. (Geological Survey, Denver, CO); Salisbury, J.W. *Geophysics;* **43**: No. 4, 738-747(Jun 1978).

Ratio values of the reflected energy available through different Landsat band-pass filters were formed by using laboratory spectra of 284 particulate rock and soil specimens, and the potential for using these data to discriminate among rock types was examined. On the basis exclusively of the intrinsic spectral information in the multispectral scanner (MSS) bands (textural, geomorphic, and vegetational effects that may occur in the field were excluded), it was concluded that the ratios can generally be used to discriminate different lithologic units. Further, only mafic and ultramafic rocks, and alteration involving ferric oxide staining, typically display sufficiently characteristic spectral behavior to allow specific identification. Certain unique features, such as those produced by chromium in some chloritic quartzites, can be used for discrimination of a few rare rock types. 10 figures.

GEOPHYSICS

GEOPHYSICAL SURVEY METHODS

REFER ALSO TO CITATION(S) 9067

9386 (LBL—7053) **Workshop on modeling of electric and electromagnetic methods.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978. Contract W-7405-ENG-48. 209p. (CONF-7805163—). Dep. NTIS, PC A10/MF A01.

From Workshop on modeling of Electrical and Electromagnetic methods; Berkeley, CA, USA (17 May 1978).

Twenty-two papers are included. Separate abstracts were prepared for eighteen and four were listed by title. A summary of the papers given is presented along with conclusions drawn and recommendations made by the conference participants. A list of participants is also included. (MHR)

9387 (LBL—7053, pp 8-19) **Application of the finite element method to the finite source 2-D earth E-M problem.** Stodt, J. (Univ. of Utah, Salt Lake City). 1978.

From Workshop on modeling of Electrical and Electromagnetic methods; Berkeley, CA, USA (17 May 1978).

An outline of the application of the Galerkin finite element method to the solution of the finite source 2-D earth E-M problem is presented.

9388 (LBL—7053, pp 27-35) **3D finite element modeling of electric and electromagnetic data.** Pridmore, D. (Univ. of California, Berkeley). 1978.

From Workshop on modeling of Electrical and Electromagnetic methods; Berkeley, CA, USA (17 May 1978).

A finite element code was written to solve three dimensional resistivity and electromagnetic problems. In both cases, the minimum theorem (Stakgold, 1968, p. 338) was used to give a variational statement. Results from this code were in satisfactory agreement with those obtained from Hohmann's 3D integral equation algorithm (Hohmann, 1977, personal communication) for resistivity modeling, and for electromagnetic modeling where the conductivity contrasts between the body and the half space were less than two orders of magnitude. The details of the finite element technique and the comparison between the different results are given by Pridmore (1978). The problems encountered in the work by Pridmore (1978) are outlined and some general suggestions for future endeavors are offered.

9389 (LBL—7053, pp 36-52) **Transient time domain electromagnetics.** Kuo, J.T.; Cho, D.H. (Columbia Univ., New York, NY). 1978.

From Workshop on modeling of Electrical and Electromagnetic methods; Berkeley, CA, USA (17 May 1978).

With externally impressed electric and magnetic sources, the electric and magnetic field equations may be derived from the symmetrical Maxwell's equations. Two variational principles for the initial boundary value problem of electromagnetics are derived. The first one of the Gurtin type is deduced from the integro-differential equations equivalent to the electromagnetic field equations, while the second one is a simplified version of the first variational principle. The variational field equations are casted into the form suitable for a finite element formulation in space. An explicit central-differences scheme in time is then applied to the finite element variational equation to yield a recursive relation for time integration. The results of the Newmont Electromagnetic Pulse (EMP) survey done in the Mutooroo prospect in Australia is numerically verified by a Turam approximation.

9390 (LBL—7053, pp 53-61) **EMMMMA: a computer program for three dimensional modeling of airborne electromagnetic surveys.** Scheen, W.L. (Kon/Shell Exploratie en Produktie Lab., Rijswisk, Holland). 1978.

From Workshop on modeling of Electrical and Electromagnetic methods; Berkeley, CA, USA (17 May 1978).

EMMMMA stands for Electromagetic Mathematical Model Mixed Algorithm. The program calculates the response observed in airborne dipole-dipole e.m. surveys caused by conductive bodies within a horizontally stratified earth. Working with a certain mesh consisting of tetrahedrons, the program uses a variational principle for setting up a set of finite element equations for the magnetic field. A second set of equations, based in integral relations, expresses the fields at the boundary nodes of the mesh in terms of those at the interior nodes. The same integral relation is used to compute the field at the receiver. Some results with simple models are shown and problems encountered are discussed. Two versions of this program are being tested.

9391 (LBL—7053, pp 62-75) **Scale model of the TEM method.** Spies, B.R. (Macquarie Univ., Sydney, Australia). 1978.

From Workshop on modeling of Electrical and Electromagnetic methods; Berkeley, CA, USA (17 May 1978).

Scale model studies of the TEM method are being conducted at Macquarie University, Sydney, using an interactive mini-computer for timing of waveforms, data acquisition, and processing. In order to construct realistic geological models, it is necessary to simulate host rock, overburden, and mineralization. With TEM modelling it is not possible to scale time by a factor in excess of about 10. For these reasons the conventional salt or acid tank is not satisfactory, and other techniques have had to be developed. Models used in the facility consist of low- and medium-melting point alloys (typemetal, Wood's metal, etc.) graphite, and conductive epoxy resins. The main difficulties experienced with this modelling setup are: (1) when time is scaled, sampled times need to be known to a very high precision. Wide time windows are unsatisfactory. (2) It is difficult to determine the electrical continuity between adjacent materials.

9392 (LBL—7053, pp 93-105) **2-D inversion of dc resistivity.** Tripp, A.C. (Univ. of Utah, Salt Lake City). 1978.

From Workshop on modeling of Electrical and Electromagnetic methods; Berkeley, CA, USA (17 May 1978).

The two-dimensional dc resistivity forward problem is discussed briefly. Next, the transmission surface is approximated by a network. An inversion algorithm is formulated using the linearized least squares technique. (MHR)

9393 (LBL—7053, pp 108-111) **Modeling of three-dimensional dc electrical problems using integral equation solutions.** Bartel, L.C. (Sandia Labs., Albuquerque, NM). 1978.

From Workshop on modeling of Electrical and Electromagnetic methods; Berkeley, CA, USA (17 May 1978).

A Green's function integral equation technique has been developed to calculate the electrical potentials and apparent resistivities resulting from three-dimensional structures. To illustrate the integral equation technique, the results of an illustrative model calculation are shown. The emphasis on the modeling work has been to describe field results from using electrical methods to monitor the in situ gasification of coal and retorting of oil shale and to map hydraulic fractures in the oil shale and natural gas stimulation programs. (MHR)

9394 (LBL—7053, pp 117-146) **Three-dimensional equation modeling.** Hohmann, G.W. (Univ. of Utah, Salt Lake City). 1978.

From Workshop on modeling of Electrical and Electromagnetic methods; Berkeley, CA, USA (17 May 1978).

A three-dimensional (3D) integral equation solution (Hohmann, 1975) has beed used for several years to simulate the response of the earth for various electrical prospecting methods. The computer program provides good results for dc applications, and for EM problems at low frequencies and low conductivity contrasts. However, its application to electromagnetic (EM) exploration for massive sulfides is limited due to the large amount of computer storage required for large conductivity contrasts. Recently the integro-difference method (Harrington, 1968) was incorporated in the solution for greater accuracy, and applied to magnetotelluric (MT) modeling. Convergence checks and comparisons with 2D models indicate that the results are valid. Initial calculations show that 3D models are required for MT interpretation in complex environments. The integral equation formulation, applications and limitations of the numerical solution, and initial MT results are briefly discussed.

9395 (LBL—7053, pp 147-157) **Accuracy of methods in geophysics modelling.** Stenger, F. (Univ. of Utah, Salt Lake City). 1978.

From Workshop on modeling of Electrical and Electromagnetic methods; Berkeley, CA, USA (17 May 1978).

The methods of approximation are discussed that have been used in this conference for the approximate solution of modelling problems, with emphasis on the order of the methods, especially in the presence of singularities. Theoretical analysis of the error indicate that the use of zinc methods should reduce the amount of effort in solving a problems by two orders of magnitude. (MHR)

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 8156

9396 (LBL—9884) **Characterization of discontinuities in the Stripa granite.** Thorpe, R.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 11p. (CONF-791112—27). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Characterization of the fracture system in a repository is important, and its purpose should dictate the scale over which measurements must be made. The results discussed pertain to near-field behavior of a rock mass and represent a practical limit to the degree to which discrete subsurface discontinuities can be defined by surface mapping and cross-correlation of observational borehole data. Discontinuities on the scale of the rock mass being studied can dominate its response, and should therefore be described according to their influence on the stability of the opening and local groundwater regime. Alternatively, if the size or continuity of a feature is much less than the scale of the rock mass in question, there will be insufficient data with which to validate a discrete characterization, hence a statistical approach is required.

9397 (SAND—79-1546C) **Material properties of Eleana argillite: extrapolation to other argillaceous rocks, and implications for waste management.** Lappin, A.R.; Olsson, W.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

Results of a near-surface heater test in the Eleana argillite suggest the possibility that the high-temperature (> 100°C) thermomechanical response of argillaceous rocks to waste emplacement may be dominated by behavior of expandable clays. Enough expandable clay is probably present in most argillaceous rocks to cause a similar response. In situ thermal conductivities may be markedly reduced by even small amounts of clay contraction, compensated by opening of pre-existing joints. A simple model predicts that such opening behavior may continue to operate for disposal at considerable depths, through several factors affecting this depth remain poorly defined at present.

9398 **Elastic properties, chemical composition, and crystal structure of minerals.** Shankland, T.J. (Los Alamos Scientific Lab., NM). *Geophys. Surv.;* 3: 69-100(1977).

The observed systematic relations between velocities, density, and crystal structure in minerals are viewed as part of the general problem of the interactions of ions and electrons in solids. A complete explanation of these systematics would result from an adequate physical model of interactions between atoms in a crystal. For ionic models, understanding such interactions mainly requires knowledge of interionic repulsive forces, which can be calculated from solutions for the electronic energy levels. The main forms of systematics developed in the last few years can be classed either as bulk modulus-molar volume (K-V/sub m/) or, equivalently, velocity-density (v-rho) relations. Isostructural and isochemical (having constant mean atomic weight anti m) trends exist, and for both classes of systematics it is possible to produce semi-empirical universal expressions with the ability to predict elastic properties to a few percent. The best estimates of composition of the Earth's interior come from comparisons of mineral elastic properties with seismic data. On the basis of current velocity profiles of the Earth, the mantle appears to be chemically homogeneous. 72 references, 14 figures.

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 8132

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 9067, 9254

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

9399 (UCID—18331) **Astrophysical research at Lawrence Livermore Laboratory, proposal for a formal program.** Lokke, W.A.; Tarter, C.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1979. Contract W-7405-ENG-48. 19p. Dep. NTIS, PC A02/MF A01.

Basic research is often characterized as self-directed, moving on its own timescale, spurred by the unexpected. An effective, organized basic astrophysics research program does not have to be a contradiction in terms. A broadly chartered, long-range LLL Astrophysics Research Program, created and recognized by LLL management, can benefit the general scientific community, stimulate the staff, maintain important capability, and enrich the Laboratory.

COSMIC RADIATION

9400 (UCRL—83295(Rev.1)) **Preferential acceleration in collisionless supernova shocks.** Hainebach, K.; Eichler, D.; Schramm, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1979. Contract W-7405-ENG-48. 7p. (CONF-790836—5(Rev.1)). Dep. NTIS, PC A02/MF A01.

From 16. international cosmic rays conference; Kyoto, Japan (6 Aug 1979).

The preferential acceleration and resulting cosmic ray abundance enhancements of heavy elements (relative to protons) are calculated in the collisionless supernova shock acceleration model described by Eichler in earlier work. Rapidly increasing enhancements up to several tens times solar ratios are obtained as a function of atomic weight over charge at the time of acceleration. For material typical of hot phase interstellar medium, good agreement is obtained with the observed abundance enhancements.

STARS

9401 **Numerical study of rotating relativistic stars.** Wilson, J.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp 644-675 of Physics and astrophysics of neutron stars and black holes. Giacconi, R.; Ruffini, R. (eds.). Amsterdam, Netherlands; North-Holland (1978).

Rapidly rotating neutron stars are considered to see if the mass can differ from that of a nonrotating star. With a sufficiently large amount of rotation, a star of any mass can be self-supporting. Applying Newtonian ideas suggests that the mass of a neutron star can only increase by about 50% from rotation without becoming unstable. The collapse of supermassive rotating magnetized stars is also calculated. In these calculations both magnetic braking effects and very weak jet effects are observed. Some indication of how electrically charged black holes might be formed was found.

9402 **Neutrino flow and gravitational collapse.** Wilson, J.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp 676-693 of Physics and astrophysics of neutron stars and black holes. Giacconi, R.; Ruffini, R. (eds.). Amsterdam, Netherlands; North-Holland (1978).

The effects of neutrino flow in gravitational collapse have long been studied and numerous neutral-current models of elastic coherent scattering have been proposed. Calculations indicated the explosion was marginally dependent on the details of the neutrino interactions, and the calculational model has several weaknesses. The work described has been undertaken to clarify the situation and the calculations include the explicit calculation of all four neutrino types and treat both electron and neutrino degeneracy.

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

9403 Optical pulsations from HZ-Her-Her X-1. A determination of the mass of the neutron star. Middleditch, J.; Nelson, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 216-229 of Physics and astrophysics of neutron stars and black holes. Giacconi, R.; Ruffini, R. (eds.). Amsterdam, Netherlands; North-Holland (1978).

Optical observations of HZ Her reveal weak, intermittent pulsations at frequencies near to but in general not identical to the expected Her X-1 frequency. These pulsations are correlated with both the binary and 35-day phases. These pulsation-emitting regions are discernible with regions I and II evidently associated with the surface of HZ and region III associated with a region near the X-ray source itself.

SOLAR PHENOMENA

9404 (AD-A—070569) **Solar flare spectroscopic diagnostics for wavelengths less than 2000 angstroms. Interim report.** Doschek, G.A.; Feldman, U. (Naval Research Lab., Washington, DC (USA)). 27 Jun 1979. 33p. NTIS PC A03/MF A01.

We discuss the use of intensity ratios of emission lines for determining the electron density and temperature in flare plasmas. The availability diagnostics cover the temperature range from about 40000 K to about 10000000 K. We summarize the current work on flare density diagnostics and review the applications of this theory to available flare spectra. We discuss the importance of line profiles for determining nonthermal mass motions in the plasma and for estimating path lengths along the line of sight. We review the current information on line profiles in flare spectra. We comment on determining departures from ionization equilibrium using line ratios in the x-ray and EUV regions.

9405 (ATR—79(9552)-4) **Is the sun constant.** Blake, J.B.; Dearborn, D.S.P. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.; Steward Observatory, Tucson, AZ (USA)). 30 Oct 1979. 24p. Aerospace Corp., El Segundo, CA.

Small fluctuations in the solar constant can occur on timescales much shorter than the Kelvin time. Changes in the ability of convection to transmit energy through the superadiabatic and transition regions of the convection zone cause structure adjustments which can occur on a time scale of days. The bulk of the convection zone reacts to maintain hydrostatic equilibrium (though not thermal equilibrium) and causes a luminosity change. While small radius variations will occur, most of the change will be seen in temperature.

PLANETARY PHENOMENA

9406 (AD-A—071062) **On the inference of properties of Saturn's Ring E from energetic charged particle observations. Progress report.** Thomsen, M.F.; Van Allen, J.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jun 1979. Contract N00014-76-C-0016. 25p. NTIS PC A02/MF A01.

Assuming that Saturn has trapped radiation belts similar to those of Earth and Jupiter, it is shown that observations of the radial dependence of the intensities, energy spectra, electron-to-proton intensity ratio, and pitch angle distributions of energetic charged particles trapped outside of Ring A can potentially provide information on the existence of Ring E, on the size distribution of the particulate matter therein, and on the magnitude of the radial diffusion coefficient for energetic particles. A parametric study of these possibilities is specialized to the characteristics of the University of Iowa detectors on Pioneer 11, which will make a close encounter with Saturn in August-September 1979.

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

9407 (AD-A—070947) **Study to analyze and synthesize satellite data. Final report 1 October 1977-30 September 1978.** Harel, M.; Reiff, P.H.; Spiro, R.W.; Wolf, R.A. (Rice Univ., Houston, TX (USA)). 15 Jan 1979. Contract F19628-78-C-0078. 32p. NTIS PC A03/MF A01.

We have completed four computer runs simulating the behavior of the earth's inner magnetosphere during the substorm-type event that had its onset at about 1000 UT on 19 September 1976. Our program simulated many aspects of the behavior of the closed-field-line portion of the auroral and subauroral ionosphere. For these regions, the program self-consistently computes electric fields, electric currents, hot-plasma densities, plasma flow velocities and other parameters. Our computed ionospheric electric fields compare reasonably well with corresponding data from satellite S3-2. The most striking observational feature of the electric fields in the modeled region during the 19 September 1976 event was an instance of rapid subauroral flow, which was observed on the outbound part of pass 4079B South and was also predicted by the computer runs. These computer results seem consistent with a simple analytic model for rapid subauroral flow developed by Southwood and Wolf. Birkeland-current densities predicted by the model are presented, for eventual comparison with S3-2 magnetometer data. A program has been developed to follow the evolution of the plasmasphere, or any other magnetospheric or upper-ionospheric cold-plasma boundary, through a modeled event. Some interesting preliminary results for computed plasmasphere shapes are presented.

MAGNETOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 9407

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

BEAMS AND THEIR REACTIONS

9408 (JAERI-M—7797) **System for simultaneous and continuous observation of surfaces with ion bombardment.** Obara, K.; Abe, T.; Sone, K. (Japan Atomic Energy Research Inst., Tokyo). Aug 1978. 28p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

The system was installed on May 24, 1978 in the Division of Thermonuclear Fusion Research, Fusion Research and Development center, JAERI. With this system, research on the material ion-irradiation characteristics is highly efficient and detailed information of the mechanisms of surface erosion obtainable by observing and recording surface topography changes simultaneously and continuously with ion bombardment. In this report are given an outline of the system, the mechanisms of main measurements, and results of the first performance test. Its principal part is a scanning electron microscope, which is equipped with other mechanisms. A solid-state detector for detecting high-energy electrons backscattered from the target surface was newly designed and installed to obtain the backscattered electron image. Apparatus of measuring and integrating the ion current during bombardment/observation is set in the system. The performance test after installation with a 100 keV helium ion beam bombarding a molybdenum target showed a resolution of asymptotically equals 1000 A on an almost static image, which is sufficient for observing the surface deformation produced by sputtering and blistering.

9409 Method and apparatus for producing electrostatic fields by surface currents on resistive materials with applications to charged particle optics and energy analysis. Siegel, M.W. (to Extranuclear Labs., Inc.). US Patent 4,126,781. 21 Nov 1978. Filed date 10 May 1977. 20p.

Electric fields for electrostatic optics for focusing or otherwise controlling beams of ions, electrons and charged particles in general can be produced by surface current distributions which flow on appropriately shaped and located resistive elements from electrical power sources of appropriate voltage connected to two or more points or regions of the resistive surfaces; the resulting electric fields in the proximity of the current carrying surfaces are parallel to these surfaces. Useful electric field configurations may be produced which are inconvenient or impossible to produce by the prior art using surface charge distributions. New and improved analyzers of concentric hemisphere and parallel plate types are specifically utilized for ion kinetic energy selection prior to measurement of the mass-to-charge ratio of secondary ions produced by primary ion bombardment of surfaces.

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

9410 (LBL—10052) **Kaon mass by critical absorption of kaonic atom x rays.** Lum, G.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 80p. Dep. NTIS, PC A05/MF A01.

Thesis.

The energy of the kaonic 6h → 5g transition has been determined using the calculated μ/rho curve. Because the detectors used could not resolve the noncircular transitions, the predictions from a calculated cascade program were used. According to the cascade results for potassium, the number of noncircular x-rays was about 10% of all the transitions between n = 6 to n = 5. Based on the available information, the mass of the kaon was measured to be 493.576/sub -0.069//sup +0.044/ MeV. (GHT)

COLLISION PHENOMENA

9411 (CONF-790996—2) **Resonant dissociation in N_2 by electron impact: a source of heating in the thermosphere and auroras.** Spence, D.; Burrow, P.D. (Argonne National Lab., IL (USA);

Nebraska Univ., Lincoln (USA). Behlen Lab. of Physics). 1979. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From Symposium on electron-molecule collisions satellite meeting; Tokyo, Japan (6 Sep 1979).

An electron impact resonant dissociation process, leading to superthermal atom production in molecular nitrogen is described. The maximum cross section for this process is found to be 2.5 x 10^{-18} cm^2 at 10 eV. Measurements of scattered electrons indicate a value of -65 to -90 MeV for the electron affinity of N. The possible role of resonant dissociation as a source of heating in the thermosphere and in auroras is discussed.

9412 (LBL—9988) **Resonant multiphoton dissociation of ethyl chloride at 3.3 μm.** Kung, A.H.; Dai, H.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-4. 7p. (CONF-791047—4). Dep. NTIS, PC A02/MF A01.

From 11. annual electro optics/laser conference and exposition; Anaheim, CA, USA (23 Oct 1979).

The interest in multiphoton dissociation (MPD) of molecules stems from the discovery of high isotopic selectivity for the process in 1974. Recently enrichment ratios in excess of 10^4 have been achieved for deuterium separation using trifluoromethane and > 30 with high yield for carbon 13 using CF_3I. A pilot plant has been set up for large scale productions of carbon 13. While these advances in practical applications are made, work is going on to understand the physics of the process. Most of the work is concentrated on molecules excitable by the CO_2 laser for the obvious reason that the light source is easily available. However, a number of groups have also been studying excitation of the hydrogen stretches. The hydrogen stretch is of great interest because each quantum absorbed by the H-stretches is about three times the energy of a CO_2 laser quantum, and thus a higher fraction of the dissociation energy. On the other hand, hydrogen stretches have relatively higher anharmonicity and may be weakly coupled to the rest of the molecule. The effect of these on MPD is explored.

9413 (SAND—79-2305C) **Bonding, Shake-up energies and shake-up intensities in $Cr(NO)_4$.** Loubriel, G. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1979. Contract EY-76-C-04-0789. 14p. (CONF-791013—9). Dep. NTIS, PC A02/MF A01.

From 26. national vacuum symposium; New York, NY, USA (2 Oct 1979).

The results of SCF-Xα-multiple scattering calculations of the electronic structure of $Cr(NO)_4$ in its neutral ground state and in several positive-ion states are reported. This allows a description of the bonding of NO to the Cr atom, explains how the screening of core holes (created in a XPS measurement) is affected and yields the N/sub ls/ shake-up spectrum. There is good agreement with the experimental valence region photo-emission spectra peak positions and with the skake-up peak positions and intensities.

MAGNETOHYDRODYNAMICS

REFER ALSO TO CITATION(S) 8744

SUPERFLUIDITY

9414 (UCRL—52826) **High-energy air shock study in steel and grout pipes.** Glenn, H.D.; Kratz, H.R.; Keough, D.D.; Duganne, D.A.; Ruffner, D.J.; Swift, R.P.; Baum, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Oct 1979. Contract W-7405-ENG-48. 60p. Dep. NTIS, PC A04/MF A01.

Voitenko compressors are used to generate 43 mm/μs air shocks in both a steel and a grout outlet pipe containing ambient atmospheric air. Fiber-optic ports provide diaphragm burst times, time-of-arrival (TOA) data, and velocities for the shock front along the 20-mm-ID exit pipes. Pressure profiles are obtained at higher enthalpy shock propagation than ever before and at many locations along the exit pipes. Numerous other electronic sensors and postshot observations are described, as well as experimental results. The primary objectives of the experiments are as follows: (1) provide a data base for normalization/improvement of existing finite-difference codes that describe high-energy air shocks and gas propagation; (2) obtain quantitative results on the relative attenuation effects of two very different wall materials for high-energy air shocks and gas flows. The extensive experimental results satisfy both objectives.

HIGH ENERGY PHYSICS

9415 (UH—511-360-79) **Eighth Hawaii topical conference in particle physics.** Jones, M.D.; Pramudita, A. (eds.). (Hawaii Univ., Honolulu (USA)). 1979. Contract EY-76-C-03-0511. 83p. (CONF-790898—(Summ)). Dep. NTIS, PC A05/MF A01.

From 8. Hawaii topical conference in particle physics; Honolulu, HI, USA (8 Aug 1979).

Summaries of 21 papers from a conference on particle physics are presented. (JFP)

9416 **XI international school on high energy and relativistic nuclear physics for young scientists.** Dubna, USSR; Joint Institute for Nuclear Research (1979). 552p. (JINR—D2-11707; CONF-7709177—).

From 11. international school for young scientistis on high energy physics and relativistic nuclear physics; Gomel, Byelorussian SSR (12 Sep 1977).

The conference contained 15 papers on high energy physics. (JFP)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

9417 (SLAC-PUB—2367) **Further tests of parity violation in inelastic electron scattering.** Prescott, C.Y. (Stanford Linear Accelerator Center, CA (USA)). Aug 1979. Contract EY-76-C-02-0515. 8p. (CONF-790642—8). Dep. NTIS, PC A02/MF A01.

From International conference on high energy physics; Geneva, Switzerland (27 Jun 1979).

Further measurements of parity-violating asymmetries in inelastic scattering of polarized electrons from deuterium were made for a range of y values from 0.15 to 0.36. Only a small y-dependemce was observed in the asymmetries. Using the quark-parton model, these results are in good agreement with the Weinberg-Salam predictions. A value of the parameter $\sin^2\theta$/sub W/ = 0.224 +- 0.020 was obtained. 4 figures.

WEAK INTERACTIONS

9418 (BNL—26829) **Review of multilepton production in neutrino nucleon interactions.** Murtagh, M.J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 15p. (CONF-790885—8). Dep. NTIS, PC A02/MF A01.

From 9. international symposium on lepton and photon interactions at high energy; Batavia, IL, USA (23 Aug 1979).

The emphasis in this review of multiplepton production in neutrino-nucleon interactions with regard to opposite sign dileptons is not on establishing their origin, but rather on the extent to which the new data expand on knowledge of charm production in neutrino interactions. In this regard, it is found that the opposite sign dilepton events are clearly consistent with being predominantly single charm production. There is now evidence in these data for charmed baryon as well as charmed meson production. Included in the survey are the theoretical expectations, rates for dilepton production by neutrinos and by antineutrinos, determination of the S-quark content of the nucleon, strange particle production in $\mu^- e^+$ dilepton events, strange particle production in anti ν interactions, trilepton production, and the same-sign dilepton production. 33 references. (JFP)

9419 (FERMILAB-Conf—79/36-THY) **Signals for tau neutrino events in a beam dump experiment.** Albright, C.H.; Shrock, R.E.; Smith, J. (Fermi National Accelerator Lab., Batavia, IL (USA); Princeton Univ., NJ (USA). Dept. of Physics; European Organization for Nuclear Research, Geneva (Switzerland)). May 1979. Contract EY-76-C-02-3000. 14p. (CONF-790648—9). Dep. NTIS, PC A02/MF A01.

From Neutrino 1979 conference; Bergen, Norway (18 Jun 1979).

Ways of detecting tau neutrinos emerging from a beam dump are studied. Key signatures are elaborated and contrasted with background arising from muon and electron neutrino interactions. Expected event rates are given for various neutrino spectra. 16 references.

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 9418

9420 (COO—4195-3) **Proton spectra from 800 MeV protons on selected nuclei. Progress report, January 1, 1979-December 31, 1979.** Stearns, R.L. (Vassar Coll., Poughkeepsie, NY (USA)). Sep 1979. Contract EG-77-S-02-4195. 47p. Dep. NTIS, PC A03/MF A01.

The emission of protons from targets of ^{6}Li, Li, ^{12}C, ^{27}Al, ^{40}Ca, ^{51}V, ^{90}Zr, and Pb under bombardment from 800 MeV protons was studied using the high resolution proton spectrometer at the Los Alamos Meson Physics Facility. Laboratory scattering angles of 5, 7, 9, 11, 13, 15, 20, 25, and 30° were measured, with special emphasis on the quasi-free region. Outgoing momenta corresponding to the region of pion production were examined at 11 and 15°. Absolute

cross sections derived by reference to known (p,p) scattering data at 800 MeV. The quasi-free scattering has been fit with a DWIA analysis by summing over the unobserved (struck) nucleon. The systematics of proton production and the applicability of the DWIA analyses are discussed. 26 references.

9421 Fits to particle monenta spectra in streamer chamber experiment with two temperature Boltzmann model. Allen, R. (Lehigh Univ., Bethlehem, PA); Kanofsky, A.; Hasan, A. pp 203-204 of Meson-nuclear physics, 1979 (Houston). Hungerford, E.V. III (ed.). New York, NY; American Institute of Physics (1979).

From 2. international conference on meson-nuclear physics; Houston, TX, USA (5 Mar 1979).

Results are presented of the Boltzmann two-temperature fits to the momentum spectra of low energy particles resulting from collisions of beam particles with the nuclei of atoms of a streamer chamber gas. Results are given for proton, pion plus minus reactions with helium and neon in the chamber. 2 references. (JFP)

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 9418, 9421

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

9422 (SLAC-PUB—2396) **Impact of higher twist terms on the analysis of scaling violation.** Barnett, R.M. (Stanford Linear Accelerator Center, CA (USA)). Sep 1979. Contract EY-76-C-03-0515. 34p. (CONF-790774—1). Dep. NTIS, PC A03/MF A01.

From SLAC summer institute on particle physics: quantum chromodynamics; Stanford, CA, USA (9 Jul 1979).

A critical discussion is given of analyses of scaling violation in deep-inelastic scattering in the context of QCD. Several possible approaches are examined. Higher twist contributions are defined, and it is shown that they can have a crucial impact on tests of QCD. Higher twist terms can dramatically affect R = σ/sub L//σ/sub T/ . QCD may be harder to test than previously realized. 17 references.

ELECTROMAGNETIC INTERACTIONS

9423 (COO—2114-40) **Notes on upsilon production.** Nauenberg, U. (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics). 5 Jun 1979. Contract EY-76-C-02-2114. 8p. Dep. NTIS, PC A02/MF A01.

After making a survey of previous work on photoproduction of vector mesons in the context of the vector meson dominance model, the upsilon region was studied using the surveyed results. An attempt was made to determine some simple regularities in the data that would allow extrapolation to the upsilon production region and an estimate of the cross section. The fundamental equation of vector meson dominance for the $\gamma p \rightarrow Vp$ interaction is considered. From this equation the differential cross section for vector meson scattering and finally for the upsilon photoproduction cross section are evaluated. The vector meson-photon coupling constant is also plotted as is the cross section for the studied reaction. (JFP)

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 9418

9424 (SLAC-PUB—2423) **Angular distributions in the lepton pair production.** Stroynowski, R. (Stanford Linear Accelerator Center, CA (USA)). Oct 1979. Contract EY-76-C-03-0515. 7p. (CONF-7909104—1). Dep. NTIS, PC A02/MF A01.

From 10. international symposium on multiparticle dynamics; Goa, India (25 Sep 1979).

The angular distributions of high mass lepton pairs are reviewed. It is argued that the detailed study of polar distributions provide the evidence for the substantial contributions to the Drell-Yan process from the higher order QCD effects. It is also pointed out that the first order QCD Compton diagrams predict nontrivial azimuthal dependence which could be measured experimentally. 13 references.

STRONG INTERACTIONS, GENERAL

9425 (FERMILAB-Conf—79/74-THY) **Bound state of heavy quarks and antiquarks.** Quigg, C. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1979. Contract EY-76-C-02-3000. 19p. (CONF-790885—10). Dep. NTIS, PC A02/MF A01.

From 9. international symposium on lepton and photon interactions at high energy; Batavia, IL, USA (23 Aug 1979).

Properties of the charmonium and upsilon families of heavy mesons are reviewed within the framework of quarkonium quantum mechanics. The implications of current data are analyzed and projections are made for heavier quarkonium families. 72 references.

9426 (LBL—10094) **Heavy quark jets.** Suzuki, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 12 Nov 1979. Contract W-7405-ENG-48. 17p. (CONF-7910103—1). Dep. NTIS, PC A02/MF A01.

From Workshop on the production of new particles in super high energy collisions; Madison, WI, USA (22 Oct 1979).

The present understanding of heavy quark fragmentation is reviewed, and the expected behaviors of heavy quark jets is discussed. Included are short-distance versus long-distance parts of fragmentation, fragmentation dynamics at long distances, universal hadronization in rapidity plot, the heavy quark as a sizzling fireball, quantum chromodynamics ladder summation in the region of K/sub T/ $< \Lambda$, and the relevance or irrelevance to super high energy experiment. 6 references. (JFP)

STRONG INTERACTIONS, BARYON NO.=0

REFER ALSO TO CITATION(S) 9418, 9423

9427 (FERMILAB-PUB—78/60-THY) **Hadron masses in quantum chromodynamics on the transverse lattice.** Bardeen, W.A.; Pearson, R.B.; Rabinovici, E. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1979. Contract EY-76-C-02-3000. 64p. Dep. NTIS, PC A04/MF A01.

Calculational methods are formulated for the transverse lattice version of quantum chromodynamics. These methods are used to study the low lying spectrum of gluon bound states in the pure Yang-Mills theory. 15 references.

STRONG INTERACTIONS, BARYON NO.=1

REFER ALSO TO CITATION(S) 9418, 9427

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

9428 (FERMILAB-Conf—79/35-THY) **Quark model and high-energy nuclear experiments.** Bialas, A. (Fermi National Accelerator Lab., Batavia, IL (USA); Uniwersytet Jagiellonski, Krakow (Poland). Inst. Fizyki). May 1979. Contract EY-76-C-02-3000. 49p. (CONF-7905107—1). Dep. NTIS, PC A03/MF A01.

From 1. workshop on ultra-relativistic nuclear collision; Berkeley, CA, USA (21 May 1979).

Theoretical aspects of the measurements of production of low transverse momentum secondaries in high-energy hadron-nucleus and nucleus-nucleus collisions are discussed. Applications of the quark model to those processes are discussed in some detail. 58 references.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

GENERAL

9429 (LA-UR—79-3326) **Some remarks on the resolution of the multiplicity problem for tensor operators in U(n).** Biedenharn, L.C.; Louck, J.D. (Los Alamos Scientific Lab., NM (USA)). 19 Nov 1979. Contract W-7405-ENG-36. 17p. (CONF-791157—1). Dep. NTIS, PC A02/MF A01.

From Conference on group theoretical methods in physics; Zvenigorod, USSR (28 Nov 1979).

A canonical resolution of the multiplicity problem was proven for U(3) and this resolution is extended to a determination of all U(n) tensor operators characterized by maximal null space. 9 references.

FIELD THEORY

REFER ALSO TO CITATION(S) 9422, 9427

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

REFER ALSO TO CITATION(S) 9416

9430 (HEDL-SA—1910) **Finite element basis used in consistent nuclear data evaluation.** Schmittroth, F. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 6p. (CONF-791058—49). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

A method for the consistent evaluation of nuclear cross sections and other data is presented. The method allows the simultaneous inclusion of nuclear model calculations, microscopic and integral measurements, and the results of previously adjusted multigroup cross sections in a consistent evaluation. Complete covariance information is retained throughout the analysis.

9431 (LA—8036-PR) **Applied nuclear data research and development. Progress report, April 1-June 30, 1979.** Baxman, C.I.; Young, P.G. (Los Alamos Scientific Lab., NM (USA)). Sep 1979. Contract W-7405-ENG-36. 41p. Dep. NTIS, PC A03/MF A01.

Activities during the quarter fell into three broad categories: theory and evaluation of nuclear cross sections; nuclear cross section processing; and fission products and actinides (yields, yield theory, decay data, depletion, and buildup). Five of the articles in this report were abstracted individually. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9421

9432 **The energy dependence of the (π,N) reaction in ^{3,4}He.** Kaellne, J. (Univ. of Virginia, Charlottesville); McCarthy, J.D.; Thiessen, H.A. pp 286-287 of Meson-nuclear physics, 1979 (Houston). Hungerford, E.V.III (ed.). New York, NY; American Institute of Physics (1979).

From 2. international conference on meson-nuclear physics; Houston, TX, USA (5 Mar 1979).

A comprehensive study of the (π^-,n) in ^{3,4}He was made. The cross section was measured over the energy range 50 to 290 MeV. The energy dependence of the angular distribution was also considered. 3 references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

9433 (CONF-791219—1) **Light-particle emission from heavy-ion reactions.** Fulmer, C.B.; Robinson, R.L.; Ball, J.B. (Oak Ridge National Lab., TN (USA); Tennessee Technological Univ., Cookeville (USA); Vanderbilt Univ., Nashville, TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From International symposium on Continuum Spectra of Heavy Ion Reactors; San Antonio, TX, USA (3 Dec 1979).

Experimental studies of energetic light (Z = 1,2) ions from heavy-ion-induced reactions are reported. Energy spectra of p, d, t, ^{3}He, and α from 208.2-MeV ^{16}O on targets of carbon, iron, and zirconium show only small variations with target mass. Coincidence measurements for 194-MeV ^{12}C on ^{60}Ni show much higher multiplicity for energetic protons in coincidence with Z = 1,2 ions that with projectile-like ions. Gamma rays measured in coincidence with energetic protons show a large number of target-like nuclei to be produced with none more than 4% abundant. 8 references.

9434 **Quasielastic scattering of pions from ^{12}C and ^{40,44,48}Ca.** Blanpied, G.S. (New Mexico State Univ., Las Cruces); Burleson, G.R.; Davis, J. pp 281 of Meson-nuclear physics, 1979 (Houston). Hungerford, E.V. III (ed.). New York, NY; American Institute of Physics (1979).

From 2. international conference on meson-nuclear physics; Houston, TX, USA (5 Mar 1979).

Measurements were made of the differential cross section for π^{+-} scattered from carbon 12 and calcium 40, 44, and 48 at 180 and 290 MeV in the quasielastic region. A sample of the data is plotted for calcium 40 as a function of pion energy loss. Within errors no simple systematic effects can be seen. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9435

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9433

9435 (CONF-791058—55) **Fast-neutron total and scattering cross sections of Cr, Fe and ^{60}Ni.** Smith, A.B.; Guenther, P.T.; Whalen, J.F. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Neutron total cross sections are measured with broad resolutions (50 to 100 keV) from $\approx$ 1.0 to 4.5 MeV at intervals of $\leqq$ 50 keV and to accuracies of $\approx$ 1% using a variety of sample thicknesses. Differential elastic-scattering cross sections are measured at $\geqq$ 10 scattering angles distributed between 20 to 160 deg. from $\approx$ 1.5 to 4.0 MeV at intervals of $\leqq$ 50 keV. Angle-integrated elastic scattering cross sections are deduced from the measured values to accuracies $\geqq$ 5%. Inelastic-neutron-scattering cross sections are determined up to incident neutron energies of 4.0 MeV, at scattering angles distributed between 20 to 160 deg., and for 5 observed excitations in Cr, for 7 in Fe and for 6 in ^{60}Ni. The experimental results are discussed in terms of conventional optical-statistical models with attention to cross section fluctuations and in the context of direct-scattering processes. The experimental and calculational results are compared with the corresponding evaluated quantities given in the ENDF/B file with attention to regions of agreement and inconsistency. 14 references.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9439

9436 (LA—8036-PR, pp 3-7) **Arsenic calculations.** Arthur, E.D. Sep 1979.

In Applied nuclear data research and development. Progress report.

Q values and threshold energies for neutron reactions with ^{74}As and ^{75}As are tabulated. The total cross section for n + ^{75}As is shown from 0.1 to 20 MeV, along with the optical parameters used. Excitation functions for ^{74}As(n,2n) and ^{75}As(n,2n) reactions are plotted from threshold to 20 MeV; modified statistical model codes were used for the calculations. ^{74}Ge(p,n) cross sections from 3 to 6 MeV are also shown, along with optical parameters. 3 figures, 3 tables. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9435

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9433, 9435

9437 (CONF-791058—60) **Discrepancy between differential and integral results for the ^{63}Cu(n,α)^{60}Co cross sections.** Winkler, G.; Smith, D.L.; Meadows, J.W. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The threshold-reaction ^{63}Cu(n,α)^{60}Co is of special importance in reactor dosimetry for long-term fast-flux integration. The inconsistency in the available differential and integral data base has limited the applicability of that reaction as a reliable monitor. The availability of results from a recent measurement of the excitation function for the reaction ^{63}Cu(n,α) at ANL prompted a further investigation of this problem. The implications of the new data are discussed. 24 references.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 9448

NUCLEAR REACTIONS AND SCATTERING

9438 (LA—8036-PR, pp 8-12) **Average neutronic properties of prompt fission products.** Arthur E.D.; Foster, D.G. Jr. Sep 1979.

In Applied nuclear data research and development. Progress report.

The calculated total cross section for n + Xe is shown from 0.1 to 20 MeV, along with the relevant optical parameters; experimental data are also provided. Calculated s-wave strength for Xe isotopes are compared with experimental results. 2 figures, 2 tables. (RWR)

9439 (LA-UR—79-3332) **Neutron cross section calculations for fission-product nuclei.** Arthur, E.D.; Foster, D.G. Jr. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 13p. (CONF-791223—1). Dep. NTIS, PC A02/MF A01.

From NEANDC specialist meeting on neutron cross sections of fission product nuclei; Bologna, Italy (12 Dec 1979).

To satisfy nuclear data requirements for fission-product nuclei, Hauser-Feshbach statistical calculations with preequilibrium corrections for neutron-induced reactions on isotopes of Se, Kr, Sr, Zr, Mo, Sn, Xe, and Ba between 0.001 and 20 MeV. Spherical neutron optical parameters were determined by simultaneous fits to resonance data and total cross sections. Isospin coefficients appearing in the optical potentials were determined through analysis of the behavior of s- and p-wave strengths as a function of mass for a given Z. Gamma-ray strength functions, determined through fits to stable-isotope capture data, were used in the calculation of capture cross sections and gamma-ray competition to particle emission. The resulting (n,γ), (n,n'), (n,2n), and (n,3n) cross sections, the secondary neutron emission spectra, and angular distributions calculated for 19 fission products will be averaged to provide a resulting ENDF-type fission-product neutronics file. 11 references.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9442, 9443

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9433

9440 (BNL—26884) **Doppler broadening effect to neutron resonance cross sections for Ag, AgCl, and Ag_2O.** Liou, H.I.; Chrien, R.E.; Moreh, R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-791058—52). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The neutron capture yield of the 16.3 eV resonance in ^{107}Ag was measured, using targets of Ag metal, AgCl and Ag_2O at room, liquid N_2 and He temperatures. The effective temperature T' defined by Lamb for weak binding, and subsequently the Debye temperature θ/sub D/, were extracted for each case by a least squares shape fit. For Ag metal the measured θ/sub D/ values agree with both the simple Debye theory and a prediction of the Ag lattice dynamics. The θ/sub D/ values for AgCl and Ag_2O show some variations with temperature. The results for AgCl at 77.2 and 4.066°, however, agree with the inelastic scattering and calorimetric data. 12 references.

9441 (BNL—26885) **Stellar nucleosynthesis and the 24-keV neutron capture cross sections of some heavy nuclei.** Bradley, T.; Parsa, Z.; Stelts, M.L.; Chrien, R.E. (New Jersey Inst. of Tech., Newark (USA); Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 4p. (CONF-791058—51). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The neutron capture cross sections of ^{112}Sn, ^{130}Ba, ^{146}Nd, ^{148}Nd, ^{186}W, ^{190}Os, and ^{192}Os at 24 keV neutron energy were measured with respect to ^{197}Au by activation in a 24 keV neutron beam at the Brookhaven High Flux Beam Reactor. The reliability of this technique was verified by remeasuring the cross section of ^{186}W and comparing it to previous measurements. This continuing series of measurements will provide a more reliable data base for nucleosynthesis calculations. 12 references.

9442 (BNL—26897) **Search for new isotopes at Brookhaven.** Alburger, D.E. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 42p. Dep. NTIS, PC A03/MF A01.

A review is given of experiments leading to the discovery of new isotopes and their properties. 25 references. (JFP)

9443 (COO—4052-23) **Investigations of nuclear structure and nuclear reactions induced by complex projectiles. Technical progress report, November 1, 1978-October 31, 1979.** Sarantites, D.G. (Washington Univ., St. Louis, MO (USA). Dept. of Chemistry). 1979. Contract EY-76-S-02-4052. 45p. Dep. NTIS, PC A03/MF A01.

Experimental research on nuclear structure and reactions both published and in progress is summarized. Included are fusion reactions, strongly damped heavy ion collisions, and nuclear structure at high angular momentum. A list of publications is included. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

9444 (CONF-790976—8) **Structure of neutron deficient odd-proton nuclei near the shell closure at Z = 82.** Zganjar, E.F. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-26. 14p. Dep. NTIS, PC A02/MF A01.

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

The experimental data on neutron-deficient, odd-proton isotopes of Au(Z = 79), Tl(Z = 81), and Bi(Z = 83) relevant to core particle coupling schemes and the shell model intruder state phenomenon are presented. The data show that, near the Z = 82 closed proton shell, the unpaired necleon can be used to probe the structure of the core. It is demonstrated that the description of this process in terms of core-particle coupling models enables on to quantify and systematize a large body of experimental data and, consequently, to provide new insights into the relevant nuclear structure. The purity of the particle/hole configurations is discussed. Information on the mechanisms responsible for the disappearance of the Z = 82 shell model gap as the neutron number decreases is obtained from the spectrum of states which result from the coupling of the intruder particle and the even-even core. The observed band structure indicates that the instrusion of the extra shell proton (or proton hole) into the low-energy structure of the neutron-deficient odd-A Au, Tl, and Bi isotopes is not strongly related to the deformation of the core. 6 figures.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 9441, 9462

9445 (CONF-791058—54) **Photoneutron leakage from the W(γ,n) reaction at radiation therapy centers.** Holt, R.J.; Jackson, H.E.; Specht, J.R. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 4p. Dep. NTIS, PC A01/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The energy spectrum of photoneutrons from W(γ,n) was observed for an electron energy of 10 MeV by using the ANL high-current electron linac and a neutron time-of-flight spectrometer.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

REFER ALSO TO CITATION(S) 9441, 9462

NUCLEAR REACTIONS AND SCATTERING

9446 (BNL—50991, pp 71-81) **Evaluation of ^{241}Am resonance parameters and their consequences for the unresolved region.** Derrien, H.; Fort, E.; Lafond, D. (CEN, Cadarache, France). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

The evaluation of a set of resonance parameters of ^{241}Am was done after examination of all the available data. Only some of the main results are given here, with emphasis on the average parameters obtained, and the consistency between the cross sections calculated with the recommended parameters and some measured total, absorption, and fission cross sections in the low energy range. In the unresolved region a statistical calculation of the cross sections using the Hauser-Feshbach formalism was done, and preliminary results are given. 2 figures, 1 table.

9447 (BNL—50991, pp 83-131) **^{242}Pu: preliminary evaluation with consideration of ^{240}Pu, and some sensitivity results.** Jary, J.; Lagrange, C.; Philis, C. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

A preliminary evaluation of ^{242}Pu nuclear data is presented for the neutron energy range from 10 keV to 20 MeV. The fission cross section is based upon recent experimental measurements on ^{242}Pu. The remaining cross sections were calculated by use of various nuclear models with parameters obtained mainly by both fits on ^{240}Pu experimental data and general reflexions on the actinides. Particular care was taken of the direct interactions. The laws of secondary neutron energy spectra and the average number of neutrons produced per fission were evaluated. The results were put in ENDF/B-IV format and combined with the low-energy region of ENDF/B-IV MAT = 1161 data to make complete the evaluation over the whole energy range 10^{-5} eV to 20 MeV. Finally, the sensitivities of some of these nuclear data available for reactor calculations are given in terms of the variation of the calculated critical masses. 21 figures, 4 tables.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 8499, 9447

9448 **Decay spectra of fission products from uranium-235 thermal fission: comparison of calculations with experiments.** Stamatelatos, M.G.; England, T.R. (Los Alamos Scientific Lab., NM). *Nucl. Technol.;* **45**: No. 3, 219-232(Oct 1979).

Delayed fission product beta and gamma decay spectra following short and long ^{235}U thermal-neutron irradiations and cooling times were calculated and compared with corresponding experimental results that have recently become available. These decay-heat source terms are of importance to nuclear reactor safety, particularly to loss-of-coolant accident analyses. The comparisons between calculations and experiments showed that the state-of-the-art computational methods and the ENDF/B-IV-based nuclear data bases are generally adequate for ^{235}U thermal fission product spectral source term calculations. These comparisons also revealed some shortcomings in the data base for short-lived nuclides whose influence on the aggregate fission product spectra is mostly noticeable at very short cooling times. 20 figues, 2 tables.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 9455

NUCLEAR REACTIONS AND SCATTERING

9449 (BNL—50991) **Proceedings of the specialists' meeting on nuclear data of plutonium and americium isotopes for reactor applications.** Chrien, R.E. (ed.). (Brookhaven National Lab., Upton, NY (USA)). May 1979. Contract EY-76-C-02-0016. 388p. (NEANDC-L—116; CONF-781174—). Dep. NTIS, PC A17/MF A01.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

Separate abstracts were prepared for 17 of the papers in these Proceedings. The remaining six have already been cited in ERA, and can be located by referring to the entry CONF-781174— in the Report Number Index. (RWR)

9450 (BNL—50991, pp 33-47) **Measurements of fast neutron capture and fission cross sections of minor actinide isotopes.** Wisshak, K. (Kernforschungszentrum Karlsruhe GmbH, Germany); Kaeppeler, F.; Hage, W. May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

The neutron capture cross sections of ^{240}Pu, ^{242}Pu and ^{241}Am were measured in the energy range from 10 to 250 keV, with ^{197}Au and ^{238}U as standards. The subthreshold fission cross sections of ^{240}Pu and ^{241}Am were determined relative to ^{235}U in the energy range from 10 to 250 keV and 10 keV to 1 MeV, respectively. Continuous neutron spectra and in one case monoenergetic neutrons were produced by means of the Li(p,n) and T(p,n) reactions with the Karlsruhe 3-MV pulsed Van de Graaff accelerator. Capture events were detected by a Moxon Rae detector, and fission events, observed with a NE213 liquid scintillator. The high neutron flux available at flight paths as short as 50 to 135 mm allowed a statistical accuracy of 1 to 3% for most of the measured data together with a moderate energy resolution of 10 to 30 ns/m. An overall uncertainty between 5 and 10% was obtained in most of the measurements. A comparison is made to recent data of other authors and to evaluated files. 8 figures, 1 table.

9451 (BNL—50991, pp 49-55) **Neutron total cross sections of ^{240}Pu and ^{242}Pu in the energy range from 10 to 375 keV.** Kaeppeler, F.; Hong, L.D.; Beer, H. (Kernforschungszentrum Karlsruhe GmbH, Germany). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

The total neutron cross sections of ^{240}Pu and ^{242}Pu were determined in the energy range from 10 to 375 keV by transmission measurements using the time-of-flight technique. The data were obtained with a resolution of 0.8 ns/m. The overall uncertainties of typically 3% for ^{240}Pu and 6.5% for ^{242}Pu are dominated by systematic uncertainties, while the statistical uncertainties were well below 1% except for energies smaller than 25 keV. 2 figures, 3 tables.

9452 (BNL—50991, pp 133-163) **Cross-section data for the higher Pu and Am isotopes in the fast neutron energy region.** Patrick, B.H. (AERE, Harwell, England). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

The status of the differential total, fission, capture, elastic, and inelastic scattering cross-section data on ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, and ^{243}Am is examined in the neutron energy range from 10 keV to 20 MeV. The accuracies achieved are compared to those required in order to identify areas where the needs have been met or where further work is necessary. 12 figures, 11 tables.

9453 (BNL—50991, pp 165-176) **Evaluation of high plutonium isotopes for the German nuclear data file KEDAK.** Goel, B. (Kernforschungszentrum Karlsruhe GmbH, Germany). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

Evaluations performed at KfK for high plutonium isotopes above the resolved resonance region are described. The data discussed are capture cross sections for ^{240}Pu, ^{241}Pu, and ^{242}Pu and the fission cross section for ^{241}Pu. The evaluated data have the effect of reducing k/sub eff/ for assemblies with high ^{240}Pu content. For the dirty JEZEBEL assembly this reduction is 1.17%. The contribution of the evaluated data in reducing the discrepancy between the calculated and experimental values of the sodium void effect is more than 5%. 6 figures, 3 tables.

9454 (BNL—50991, pp 177-187) **Discrepancies in thermal cross sections for ^{241}Am.** Goel, B. (Kernforschungszentrum Karlsruhe GmbH, Germany). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

Discrepancies in the thermal capture cross section for ^{241}Am have differently been reported. In some evaluated data files the 2200 m/s capture cross section is even larger than the measured total cross section. This discrepancy arises from the fact that the total cross section is measured with monoenergetic neutrons, whereas the capture cross section is derived from the integral measurements in reactor lattices. Due to strong resonances below the Cd-cutoff energy the integral measurements are difficult to interpret and lead to non-unique results. In this report discrepancies in thermal cross sections for ^{241}Am are analyzed, and recommended values for 2200 m/s cross sections are given. 2 figures, 1 table.

9455 (BNL—50991, pp 251-274) **^{242}Pu evaluation in resolved resonance region.** Menapace, E.; Motta, M.; Ventura, A. (CNEN, Bologna, Italy). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

An evaluation of ^{242}Pu for neutron-induced reactions in the energy range 0 to 1300 eV is given. Average parameters for statistical calculations in the unresolved regions are evaluated and a few comments are made on fission barrier parameters. 9 figures, 4 tables.

9456 (BNL—50991, pp 275-286) **HEDL evaluation of higher plutonium and americium cross sections for ENDF/B-V.** Mann, F.M.; Schenter, R.E. (Hanford Engineering Development Lab., Richland, WA). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

^{242}Pu, ^{244}Pu, ^{241}Am, ^{242}Am, and ^{243}Am were evaluated for ENDF/B-V by use of experimental data and nuclear model calculations. Particular attention was given to fast fission and capture cross sections.

9457 (BNL—50991, pp 327-348) **Review of integral data on higher transactinides.** Harker, Y.D.; Anderl, R.A.; Turk, E.H. (EG & G Idaho, Inc., Idaho Falls). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

A review of the status of integral measurements is presented for ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am and ^{243}Am. This review includes integral measurements pertinent to thermal reactor systems, i.e., thermal cross sections and resonance integrals, as well as measurements for fast reactor systems. It appears that for these nuclides the data for thermal reactors are in good shape; however, more work is recommended in defining the branching ratio of the capture cross section of ^{241}Am to the isomeric and ground states of ^{242}Am. Also, benchmark irradiation data are needed for cross section data testing using depletion/production codes. For fast reactors, experiments are in progress, in the UK, in France, and also in the US, with partial results available at this time. Fast integral data obtained from these measurements will be very beneficial. The recommendation pertaining to ^{241}Am and proper benchmarks for thermal reactor applications also applies to fast reactor applications. 2 figures, 10 tables.

9458 (BNL—50991, pp 349-365) **Integral experiments performed at CEA to improve the Pu higher isotope nuclear data: PLUTO programme.** Chaudat, J.P.; Hammer, P.; Martin-Deidier, L. (CEN de Cadarache, Saint-Paul-lez-Durance, France). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

The characteristics and main results of the experimental program PLUTO, developed at CEA to improve the Pu higher isotope nuclear data, are presented. The integral experiments performed aim at providing the information necessary to adjust the multigroup cross sections used for the design calculations. The comparison of the calculation to experiment deviations on the integral parameters before and after the cross-section adjustment show the improvement brought by the PLUTO program. 6 figures, 10 tables.

9459 (BNL—50991, pp 367-369) **Integral capture cross section measurements of americium isotopes in the ZEBRA reactor at Winfrith.** Glover, K.M. (AERE, Harwell, England); Wiltshire, R.A.P.; Sweet, D.W. May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

Samples of ^{241}Am and ^{243}Am were irradiated in the ZEBRA reactor at Winfrith in typical power fast reactor spectra, including a mockup of PFR. The capture cross section measurement of ^{241}Am is described in which the composition of the core, and therefore the neutron spectrum in which the irradiations took place, was a close mockup to that of a power fast reactor. The curium produced in the irradiation was separated by radiochemical techniques and estimated qualitatively and quantitatively by use of alpha counting and alpha spectrometry techniques. The partial capture cross section for the production of ^{242}Cm from ^{241}Am was found to be 1.50 +- 0.09/ barns.

9460 (BNL—50991, pp 371-379) **Meeting on nuclear data of higher Pu and Am isotopes for reactor applications: summary and conclusions.** Chrien, R.E. (ed.). (Brookhaven National Lab., Upton, NY). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

The purpose of this workshop was to assess the present status of measurements of cross sections and other nuclear data for the isotopes of Pu and Am relevant to reactor applications, and to assess the present and future needs for those measurements. The contents of the papers presented at the meeting are briefly summarized in this concluding talk. Seven specific recommendations and nine general recommendations are given. 1 table. (RWR)

9461 (CONF-791058—58) **Fast-neutron capture cross sections of importance in technological applications.** Poenitz, W.P. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The importance of the capture cross section of the major fertile nuclei, ^{238}U and ^{232}Th, leads to the consideration of these data. The ^{238}U (n,γ) cross section is considered of priority as it is part of the ^{238}U-^{239}Pu cycle. Experimental techniques used in the measurements of these data are considered. Data measured more recently are compared with provisions made for the possible explanations of differing results. It is concluded that the ^{238}U (n,γ) cross section is known with ~ 5% above 10 keV and fulfills the uncertainty limit for this cross section set to achieve design accuracy for k/ sub eff/ and the breeding ratio above 500 keV. Below 500 keV, the present uncertainty falls short of the required 1.5 to 3.0% uncertainty. Specific recommendations are made to resolve existing discrepancies and data uncertainties. 84 references.

9462 (CONF-791058—61) **Total-neutron cross sections of heavy nuclei.** Poenitz, W.P.; Whalen, J.F.; Smith, A.B. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Total-neutron cross sections of the heavy and actinide nuclei ^{181}Ta, ^{197}Au, ^{232}Th, ^{233}U, ^{235}U, ^{238}U, ^{239}Pu, and ^{240}Pu were measured from 30 keV to 4.8 MeV. The experimental procedures emphasized a high consistency of the measured data. Systematic uncertainties, excluding those associated with sample masses, were $\leqq$ 0.5% and statistical uncertainties were typically $\leqq$ 1.0%. At low energies attention was given to resonance self-shielding effects. The experimental results are in good agreement with ^{232}Th, ^{233}U, and ^{238}U data previously reported from this laboratory and at higher energies with the comparable values reported by Foster and Glasgow, excepting ^{240}Pu which was not studied in the latter work. The measured total-cross-sections were interpreted in terms of a spherical optical model and a deformed coupled-channels model. 31 references.

9463 (CONF-791058—62) **Evaluation of ^{235}U(n,f) above 100 keV for ENDF/B-V and the implications of a unified ^{235}U mass scale.** Poenitz, W.P.; Meadows, J.W.; Armani, R.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

A previously reported evaluation of ^{235}U(n,f) in the fast neutron energy range was updated to include data published up to the 1978 Harwell Conference on Neutron Physics. The shape of the cross section resulting from this evaluation and a normalization factor extracted from data provided within the framework of this evaluation were used by the Subcommittee on Standards and Normalizations of the Cross Section Evaluation Working Group to establish ^{235}U(n,f) for ENDF/B-V above 100 keV. The ^{235}U sample mass comparisons made between different laboratories were compiled in order to investigate the implications of different sample masses on recent ^{235}U(n,f) data. A new intercomparison of several such samples was carried out using absolute and relative alpha-counting and relative fast neutron fission counting. The result of this work is a unified ^{235}U mass scale with an uncertainty of 0.6%. 39 references.

9464 (DOE/ER/10344—1) **Neutron scattering studies in thorium and uranium. Progress report, December 1, 1978-September 1, 1979.** Beghian, L.E.; Kegel, G.H.R. (Lowell Univ., MA (USA)). 1979. Contract EY-76-C-02-3323. 21p. Dep. NTIS, PC A02/MF A01.

Experimental research on neutron scattering on thorium and uranium is summarized. A list of publications is included. (JFP)

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 9450, 9452, 9453, 9455, 9456, 9457

9465 (BNL—50991, pp 57-69) **Measurement of the fast neutron fission cross section of ^{240}Pu relative to σ/sub f/ of ^{235}U and to the H (n,p) cross section.** Kari, K.; Cierjacks, S. (Kernforschungszentrum Karlsruhe GmbH, Germany). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

The fission cross section ratios ^{240}Pu/^{235}U and the absolute fission cross sections of ^{240}Pu were measured with the fast-neutron time-of-flight facility at the Karlsruhe isochronous cyclotron. The measurements cover the energy range from 0.5 to 20 MeV and were performed with a spectrometer resolution of 0.29 ns/m. This corresponds to an energy resolution of 8.1 keV at 1 MeV and of 730 keV at 20 MeV. For the measurement of the neutron flux a novel proton-recoil device was employed. In the region from 2 to 17 MeV absolute fission cross sections were measured with a total uncertainty ranging between 3.1 and 3.5%; below 2 MeV and above 17 MeV the errors increase to 3.9%. A comparison of the present data with results from other laboratories is made. 5 figures, 3 tables.

9466 (BNL—50991, pp 239-250) **Measurement of the neutron-induced fission cross section and of the spontaneous fission half life of ^{240}Pu.** Budtz-Jorgensen, C.; Knitter, H.H. (Central Bureau for Nuclear Measurements, Geel, Belgium). May 1979.

From Conference on the nuclear data of higher plutonium and americium isotopes for reactor applications; Upton, NY, USA (20 Nov 1978).

An experiment for the measurement of the neutron-induced fission cross section of ^{240}Pu is described. In this experiment a new method for fission fragment detection was used. By electronic treatment of signals from a parallel-plate ionization chamber, fast pulses with a width of less than 30 ns, carrying the time and the energy

information with it, were obtained. Preliminary results of the neutron-induced fission cross section of ^{240}Pu are given in the energy range from 140 keV to 9.75 MeV. Also, the spontaneous fission half life of ^{240}Pu was measured; and the preliminary value is given. 6 figures.

NUCLEAR THEORY

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 8645, 9428

9467 (LBL—9638) **Multiple nucleon transfer in damped nuclear collisions.** Randrup, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 18p. Dep. NTIS, PC A02/MF A01.

This lecture discusses a theory for the transport of mass, charge, linear, and angular momentum and energy in damped nuclear collisions, as induced by multiple transfer of individual nucleons. 11 references.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

9468 (EGG-PHYS—5069) **Energy dependence of the energy loss per ion pair for protons in hydrogen and methane from 2.0 keV to 1.0 MeV.** Griffing, G.W.; Rogers, J.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1979. Contract EY-76-C-07-1570. 16p. Dep. NTIS, PC A02/MF A01.

The energy loss per ion pair of protons in gaseous hydrogen and methane has been measured for various energies in the range from 2.0 keV to 1.0 MeV. The measurements were made with a proton-recoil spectrometer in conjunction with iron and scandium filtered neutron beams. For hydrogen the experimental results indicate the energy loss per ion pair is constant in this energy range except for a possible small dependence on energy at 2.0 keV. For methane the experimental results indicate a dependence of the energy loss per ion pair on energy from 2.0 keV to approximately 200 keV. An empirical relation is obtained which fits the experimental data for methane.

9469 (LA—7396-M(Rev.)) **MCNP: a general Monte Carlo code for neutron and photon transport.** (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 449p. Dep. NTIS, PC A19/MF A01.

The general-purpose Monte Carlo code MCNP ca be used for neutron, photon, or coupled neutron-photon transport, including the capability to calculate eigenvalues for critical systems. The code treats an arbitrary three-dimensional configuration of materials in geometric cells bounded by first- and second-degree surfaces and some special fourth-degree surfaces (elliptical tori). Pointwise cross-section data are used. For neutrons, all reactions given in a particular cross-section evaluation are accounted for. Thermal neutrons are described by both the free-gas and S(α,β) models. For photons, the code takes account of incoherent and coherent scattering, the possibility of fluorescent emission following photoelectric absorption, and absorption in pair production with local emission of annihilation radiation. MCNP includes an elaborate, interactive plotting capability that allows the user to view his input geometry to help check for setup errors. Standard features which are available to improve computational efficiency include geometry splitting and Russian roulette, weight cutoff with Russian roulette, correlated sampling, analog capture or capture by weight reduction, the exponential transformation, energy splitting, forced collisions in designated cells, flux estimates at point or ring detectors, deterministically transporting pseudo-particles to designated regions, track-length estimators, source biasing, and several parameter cutoffs. Extensive summary information is provided to help the user better understand the physics and Monte Carlo simulation of his problem. The standard, user-defined output of MCNP includes two-way current as a function of direction across any set of surfaces or surface segments in the problem. Flux across any set of surfaces or surface segments is available. 58 figures, 28 tables.

9470 (NUREG/CR—1057) **Confirmation of conversion factors relating exposure and dose-equivalent index presented in ANSI N13.11.** Yoder, R.C.; Bartlett, W.T.; Courtney, J.W.; Hooker, C.D.; Holland, J.A.; Hogan, B.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract EY-76-C-06-1830. 77p. (PNL—3219). Dep. NTIS, PC A05/MF A01.

Conversion factors relating dose-equivalent index (DEI) and exposure were derived from experimental measurements. Conversion factors for computing both the deep and shallow dose-equivalent indices are presented. These conversion factors were derived for K-fluorescence x-rays with energies less than 100 keV and for National Bureau of Standards (NBS) filtered x-rays with effective energies less than 200 keV. The dose-equivalent measurements were made using a tissue-equivalent phantom with an incorporated extrapolation chamber. The experimentally derived DEI conversion factors were compared with DEI conversion factors presented in draft standard N13.11, July 1978, of the American National Standards Institute (ANSI). Notable differences were found between the conversion factors in ANSI N13.11 and those derived for K-fluorescence x-rays. The conversion factors for NBS filtered x-rays compared somewhat better with the ANSI conversion factors.

9471 (SLAC-PUB—2417) **Use of elemeatary particle interactions for radiological imaging.** Williams, S.H.; Leith, D.W.G.S. (Stanford Linear Accelerator Center, CA (USA)). 1979. Contract EY-76-C-03-0515. 3p. (CONF-791037—8). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

The potential for the use of inelastic high energy particle reactions to produce radiological images is parable to that of computerized axial tomography at a fraction of the radiation exposure. In addition, the comparison of coherently produced events to the total inelastic cross section should allow a probe of the chemical composition (i.e., average Z) of the material being studied. The performance of this technique is reviewed and some preliminary results using a 5 GeV/c π^- beam at SLAC are presented.

9472 (UCRL—52850) **Kerma factors for neutron and photons with energies below 20 MeV.** Singh, M.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Nov 1979. Contract W-7405-ENG-48. 21p. Dep. NTIS, PC A02/MF A01.

A comprehensive set of kerma factors for neutrons and photons has been computed for the International Commission on Radiological Protection's (ICRP) standard man, ICRP soft tissue, ICRP red bone marrow, ICRP eye lens, H_2O, dry air, Al, Si, ^{32}S, Ar, and four thermoluminescent dosimeter materials. The energy range for neutrons is 10^{-9} to 20 MeV, divided into 175 energy groups. For photons, the energy range is 10^{-3} to 20 MeV, and kerma factors are calculated at 144 energy values. The kerma factors were computed using the neutron group-averaged and photon pointwise Evaluated Nuclear Data Library. Results are compared with those in other works where appropriate. The use of kerma factors to convert fluence to absorbed-dose index for ICRP tissue is discussed.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 9469, 9472

9473 (CONF-791051—17) **Uncertainties and covariances of spectra derived from integral measurements.** Greenwood, L.R. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 9p. Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

The computer codes SANDANL and STAYSL have been developed to determine the errors in flux-spectra due to uncertainties in integral activation measurements, nuclear cross sections, and starting spectra. The status of input data and covariances is discussed and typical results are described.

9474 (CONF-791058—56) **Neutron dosimetry for radiation damage in fission and fusion reactors.** Smith, D.L. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The properties of materials subjected to the intense neutron radiation fields characteristic of fission power reactors or proposed fusion energy devices is a field of extensive current research. These investigations seek important information relevant to the safety and economics of nuclear energy. In high-level radiation environments, neutron metrology is accomplished predominantly with passive techniques which require detailed knowledge about many nuclear reactions. The quality of neutron dosimetry has increased noticeably during the past decade owing to the availability of new data and evaluations for both integral and differential cross sections, better quantitative understanding of radioactive decay processes, improvements in radiation detection technology, and the development of reliable spectrum unfolding procedures. However, there are problems caused by the persistence of serious integral-differential discrepancies for several important reactions. There is a need to further develop the data base for exothermic and low-threshold reactions needed in thermal and fast-fission dosimetry, and for high-threshold reactions needed in fusion-energy dosimetry. The unsatisfied data requirements for fission reactor dosimetry appear to be relatively modest and well defined, while the needs for fusion are extensive and less well defined because of the immature state of fusion technology. These various data requirements are examined with the goal of

providing suggestions for continued dosimetry-related nuclear data research.

9475 (CONF-7803117—1) **Energy dependence of fast neutron dosimetry using electrochemical etching.** Su, S.J.; Morgan, K.Z. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). 1978. Contract EY-76-S-05-4814. 13p. Dep. NTIS, PC A02/MF A01.

From Southeast regional nuclear science and engineering student conference; Gainesville, FL, USA (30 Mar 1978).

Registration of fast-neutron induced recoil tracks by the electrochemical etching technique as applied to sensitive Lexan polycarbonate foils provides a simple and inexpensive means of fast neutron personnel dosimetry. The sensitivity (tracks/neutron) of recoil particle registration is given as a function of neutron energy. Neutrons of < 4,3 MeV, 14 MeV, and 22 MeV were produced by the reactions ^{7}Li (p,n) ^{7}Be, ^{3}T (d,n) ^{4}He and ^{9}B, respectively. Results are compared with other studies using other neutron sources and conventional etching method.

9476 (LA—8112-MS) **BIGAMON: a program to process the GAMMON activation file.** LaBauve, R.J.; Battat, M.E. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

The BIGAMON program, designed to process the GAMMON activation file, is described. The program retrieves 100-group neutron reaction cross sections and 25-group gamma-ray decay spectra from the GAMMON file and bebins these data into broader multigroup sets. The photon broad group boundaries must be a subset of the Gammon group structure. 5 tables.

MEDICAL PHYSICS

RADIATION SOURCE CALIBRATION AND STANDARDIZATION

9477 **γ-ray energies for ^{88}Rb decay.** Helmer, R.G. (Idaho National Engineering Lab., Idaho Falls (USA)); Starner, J.W.; Bunker, M.E. (Los Alamos Scientific Lab., NM (USA)). *Nucl. Instrum. Methods;* **158**: No. 2, 489-492(15 Jan 1979).

The energies of the γ-rays from the decay of ^{88}Rb (17.7 min) have been determined in order to provide new calibration energies in the region above 3.5 MeV. The energies of the two high-energy lines are 4742.424 (84) and 4852.882 (27) keV.

DOSIMETRY

REFER ALSO TO CITATION(S) 9470

9478 (COO—3522-27) **Biological and clinical dosimetry. Progress report July 1, 1964-June 30, 1979.** Laughlin, J.S.; McDonald, J.C. (Sloan-Kettering Inst. for Cancer Research, New York (USA). Div. of Biophysics). 1 Sep 1979. Contract EY-76-S-02-3522. 138p. Dep. NTIS, PC A07/MF A01.

The dosimetric studies at this laboratory were initiated with the primary goal of developing systems for the determination of absorbed dose in biological research and clinical applications. The primary method under study is the local absorbed dose calorimeter, a concept initiated and developed by J. S. Laughlin. In addition, secondary dosimetric systems such as ionization chambers, chemical dosimeters and thermoluminescent dosimeters (TLD) are being developed and applied to provide an absolute basis for the evaluation and comparison of experiments, treatments, and other procedures using radiation.

9479 **Consistent set of KERMA values for H, C, N, and O for neutrons of energies from 10 to 80 MeV.** Wells, A.H. (Los Alamos Scientific Lab., NM). *Radiat. Res.;* **80**: No. 1, 1-9(Oct 1979).

A set of Kinetic Energy Released in Matter (KERMA) values for H, C, N, and O are presented based upon two sets of computer calculations. One set includes neutron energies from 20 to 80 MeV and uses the Intranuclear Cascade plus Evaporation (ICE) models. The second set includes neutron energies from 10 to 20 MeV and uses the Evaluated Nuclear Data File (ENDF/B-V) for particle species and numbers, with a modified Evaporation model for the particle energies. The 10- to 20-MeV ENDF calculations, which show good agreement with values calculated by Caswell and Coyne, were performed to allow normalization of the 20- to 80-MeV ICE calculations at 20 MeV. Values for ICRU muscle tissue and Shonka A-150 plastic are also included.

9480 **In Vivo beam localization by positron activation in pion therapy.** Mausner, L.F. (Los Alamos Scientific Lab., NM); Moinester, M.A.; Knight, J.D.; Cochavi, S.; Friedland, S.S. *Radiat. Res.;* **80**: No. 1, 10-23(Oct 1979).

Measurements have been made of the absolute yield of the positron emitters ^{11}C and ^{13}N produced by 76-MeV negative pions stopped in thick stacked-foil targets of C (as graphite), N (as boron nitride), O (as water), and a tissue-equivalent mixture. The depth distribution of radioactivity exhibits a distinct peak in the water, boron nitride, and tissue-equivalent targets which correlates well with the position and width of the pion stopping distribution and with the high-LET component of dose. There are 0.0186 ^{11}C nuclei and 0.0085 ^{13}N nuclei produced per pion stopped in water, and 0.0484 ^{11}C nuclei produced per pion stopped in nitrogen. These yields are compred to predictions of an intranuclear cascade calculation. The yields of ^{11}C and ^{13}N in the stopping region from secondary particle-induced reactions are low, and do not significantly limit the ability to localize the pion star region. The activities measured for the tissue-equivalent target agree with the predictons based on the measurements for carbon, nitrogen, and oxygen targets and are similar to the yields for water. The utilizaton of a positron camera to image the radioactivity distributon in the pion stopping region is discussed.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 9398

9481 (BNL—26976) **Energy parameters and crystal field effects in the mixed valence problem: chemically collapsed cerium.** Parks, R.D.; Shapiro, S.M.; Majkrzak, C.F.; Grier, B.H. (Polytechnic Inst. of Brooklyn, NY (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA); Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1979. Contract EY-76-C-02-0016. 10p. (CONF-791142—5). Dep. NTIS, PC A02/MF A01.

From International Conference on crystal field and structural effects in f-electron systems; Philadelphia, PA, USA (12 Nov 1979).

Previous neutron scattering studies of the mixed valence state in rare earth systems failed to reveal the presence of crystal electric field (CEF) effects. In cases studied, the characteristic charge fluctuation energies were comparable to the expected CEF energies. A system was designed in which it is possible to systematically vary the charge fluctuation energy E/sub c/ from the regime E/sub c/ $\sim \Delta$ to E/sub c/ $<< \Delta$, where Δ is the characteristic CEF energy. Results of measurements on that system are reported.

9482 (LBL—9927) **Microstructural characterization of rare earth-cobalt magnets.** Mishra, R.K.; Thomas, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 15p. (CONF-7905127—1). Dep. NTIS, PC A02/MF A01.

From 4. international workshop on rare-earth cobalt magnets; Hakone, Japan (May 1979).

Structural faults and phase transformations in R_3-Co_{17} magnets are studied using transmission electron microscopy. The magnetization mechanism in a step aged Sm (Co, Fe, Cu, Zr) alloy is determined to be by domain wall pinning in the 1:5 phase of the cellular microstructure. Limitations of the electron metallography technique to study these materials are pointed out.

SOLID STATE PLASMA

9483 (LBL—8786) **Density variation in the electron-hole liquid in stressed germanium and silicon.** Kelso, S.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 385p. Dep. NTIS, PC A17/MF A01.

Thesis.

A detailed study is presented of the variation in electron-hole pair density in the electron-hole liquid (EHL) in stressed Ge and Si. First, the variation of the density and other properties of the EHL is studied theoretically as a function of uniaxial stress in both Ge and Si. Second, the variation of the density with position is studied both theoretically and experimentally in the strain-confined electron-hole liquid (SCEHL) in Ge.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

9484 (LBL—9501) **Algorithms and computer codes for atomic and molecular quantum scattering theory. Volume I.** Thomas, L. (ed.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 417p. (CONF-790696—). Dep. NTIS, PC A18/MF A01.

From Algorithms and computer codes for atomic and molecular quantum scattering theory conference; Argonne, IL, USA (25 Jun 1979).

The goals of this workshop are to identify which of the existing computer codes for solving the coupled equations of quantum molecular scattering theory perform most efficiently on a variety of test problems, and to make tested versions of those codes

available to the chemistry community through the NRCC software library. To this end, many of the most active developers and users of these codes have been invited to discuss the methods and to solve a set of test problems using the LBL computers. The first volume of this workshop report is a collection of the manuscripts of the talks that were presented at the first meeting held at the Argonne National Laboratory, Argonne, Illinois June 25-27, 1979. It is hoped that this will serve as an up-to-date reference to the most popular methods with their latest refinements and implementations.

9485 Comment on self-inverse form of the Lorentz transformation. Cook, R.J. (Univ. of California, Livermore). *Am. J. Phys.;* **47**: No. 1, 117-118(Jan 1979).

It has been shown that the kinematic relations between two iertial reference frames in relative motion can be made symmetric by an appropriate orientation of the coordinate axes of the two frames. It follows from this symmetry and the principle of relativity that the transformation matrix, A, from one frame to the other, and its inverse, A^{-1}, are equal. This result, along with a limiting-velocity postulate, was used in a derivation of the Lorentz transformation. The present note points out that only two transformation laws are compatible with the symmetry condition $A = A^{-1}$. One of these is the Lorentz transformation and the other violates causality. Thus, if the limiting-velocity postulate is replaced by the requirement that causality be satisfied in all inertial frames, one arrives at a derivation of the Lorentz transformation based entirely on concepts which were known and widely accepted long before the advent of special relativity: the homogeneity and isotropy of space in all inertial frames, the principle of relativity, and the principle of causality. (RWR)

FUSION ENERGY

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

9486 (CEA-CONF—4257) **Electric field distribution associated with lower hybrid heating of a Tokamak plasma.** Brambilla, M. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1978. 4p. (CONF-780113—10). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 3. conference on RF plasma heating; Pasadena, CA, USA (11 Jan 1978).

The lower hybrid heating implies large electric fields near the coils or antennas used for the excitation of the waves in the plasma. The electric field distribution is discussed for a grill: inhomogeneities near metal edges, resonance cones, electron Landau damping. Evanescent eigenmodes are stressed to be very important for the evaluation of the electric field, but to little influence the reflection coefficient of the grill and the power spectrum transmitted.

9487 (CEA-CONF—4258) **Resonant magnetic pumping at very low frequency.** Canobbio, E. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1978. 4p. (CONF-780113—11). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 3. conference on RF plasma heating; Pasadena, CA, USA (11 Jan 1978).

We propose to exploit for plasma heating purposes the very low frequency limit of the Alfven wave resonance condition, which reduces essentially to safety factor $q=m/n$, a rational number. It is shown that a substantial fraction of the total RF-energy can be absorbed by the plasma. The lowest possible frequency value is determined by the maximum tolerable width of the RF-magnetic islands which develop near the singular surface. The obvious interest of the proposed scheme is the low frequency value ($f <= 10$ KHz) which allows the RF-coils to be protected by stainless steel or even to be put outside the liner.

9488 (UCRL—82922) **Gettering high energy plasma in the end loss region of the Mirror Fusion Test Facility.** Goldner, A.I.; Margolies, D.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—58). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The ions escaping from the end loss fan of the Mirror Fusion Test Facility (MFTF) neutralize when they hit the surface of the end dome. If the neutrals then bounce back into the oncoming plasma, they are likely to reionize, drawing power from the center of the plasma and reducing the overall electron temperature. In this paper we describe two methods for reducing the reionization rate and a computer code for estimating their effectiveness.

PLASMA DIAGNOSTICS

9489 (GA-A—15656) **Real time acquisition, processing, and archiving of Doublet III diagram data employing table driven software.** Glad, A.; Henline, P.; Gross, L.; McHarg, B. (General Atomic Co., San Diego, CA (USA)). Nov 1979. Contract EY-76-C-03-0167-038. 9p. (CONF-791102—80). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

This paper describes the diagnostic data acquisition, processing and archiving computer system for the Doublet III fusion research device. This paper's emphasis is mainly on the software, but provides a description of the hardware configuration. (MOW)

9490 (UCRL—82975) **HIBP primary beam detector.** Schmidt, T.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 4p. (CONF-791102—59). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A position measuring detector was fabricated for the Heavy Ion Beam Probe. The 11 cm by 50 cm detector was a combination of 15 detector wires in one direction and 63 copper bars - .635 cm by 10 cm to measure along an orthogonal axis by means of a current divider circuit. High transmission tungsten meshes provide entrance windows and suppress secondary electrons. The detector dimensions were chosen to resolve the beam position to within one beam diameter.

PLASMA KINETICS - GENERAL

9491 (Rijnhuizen—78-112) **Proposal for a modification of SPICA.** Bobeldijk, C.; Goedbloed, J.P.; Griffioen, A.C. ; Freidberg, J.P.; D'Ippolito, D.A. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Inst. voor Plasma-Fysica). Oct 1978. 194p. Dep. NTIS (US Sales Only), PC A10/MF A01.

Results and conclusions of recent experimental and theoretical screw-pinch research at Jutphaas are summarized. Based on these conclusions a modification of the toroidal vacuum chamber and the conducting shell of SPICA is proposed. The physics objectives of the modified experiment (SPICA II) as well as the planning are described. More detailed information can be obtained from the appendices.

9492 (EUR-CEA-FC—954(pt.1)) **Annual progress report of the Fontenay-aux-Roses Research Group. January 1 to December 31 1977.** (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd]. 143p.p. (In French). Dep. NTIS (US Sales Only), PC A09/MF A01.

1977 at Fontenay-aux-Roses was dominated by the assembly and starting up of TFR 600, whereas at Grenoble it coincided with a period of full scientific production on Petula and Wega. On TFR 600 a study was made on discharges in the absence of a conducting shell and on plasma purity. Tokamak physics covered the analysis of the mechanism of disruptions and the dynamics of impurities on TFR 400, and the neutral injection (circular periplasmatron). Simultaneously the heating experiments and the diagnostics for TFR 600 were actively prepared, as well as the Torre II project.

PLASMA KINETICS - EXPERIMENTAL

9493 (UCRL—82919) **Alternatives for contaminant control during MFTF plasma buildup.** Khan, J.M.; Valby, L.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—63). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The MFTF mirror device considers all low-energy species to be contaminants, since their primary effect is to erode the plasma boundary by charge-exchange reactions. Confinement for other than hydrogen isotypes is far from complete and confinement time is hardly more than transit time from the source to the end wall. The brevity of the confinement time makes it all the more necessary to prevent any contamination which might further reduce it. At Livermore, the historical solution to contaminant control has been to evaporate titanium onto cold surfaces. An alternative to this approach and its implications are considered. (MOW)

PLASMA KINETICS - THEORETICAL

9494 (AD-A—070545) **Direct solution of the equation of transfer using frequency- and angle-averaged photon escape probabilities.**

Interim report. Apruzese, J.P.; Davis, J. (Naval Research Lab., Washington, DC (USA)). 21 Jun 1979. 23p. NTIS PC A02/MF A01.

A formalism is developed which permits direct steady-state solution of the transfer equation using escape probabilities probabilities averaged over angle and frequency. A matrix of probability-based coupling coefficients, which are related to the kernel K1 is used to obtain the source function for a Doppler profile in plane-parallel geometry. Comparison with exact solutionsestablishes the high accuracy of the technique. The method is extendable to different physical situations by simply modifying the coupling coefficients.

9495 (CEA-CONF—4224) **Synchrotron radiation from high temperature plasmas.** de Barbieri, O. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1977. 8p. (CONF-7709193—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Workshop, following the course on theory of magnetically confined plasmas; Varenna, Italy (12 Sep 1977).

The old problem of synchrotron radiation emitted by high temperature thermal equilibrium plasmas has been reexamined with the help of a new high-precision numerical code. It is shown that the classical results of Trubnikov, and Drummond and Rosenbluth give losses which are lower than those we find. An explanation is given of this results, together with a simple formula for the total power emitted which is obtained by interpolation of the results of our code.

9496 (ORNL/TM—6841) **1-D transport model for analysis of expanding radius and full bore startup of tokamak plasmas.** Mense, A.T.; Houlberg, W.A.; Attenberger, S.E. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405;ENG-26. 69p. Dep. NTIS, PC A04/MF A01.

This report describes the physics models and numerical algorithms that have been used in the WHIST one-dimensional (1-D) transport code to study expanding radius vs full bore startup scenarios for tokamak plasmas. The phase of the tokamak discharge that is modeled is the time segment following plasma breakdown (and initial current channel formation) up to ignition. The code has been applied to the Oak Ridge National Laboratory (ORNL) The Next Step (TNS) reference design. The various physics models are presented, and references are made to benchmarking calculations when they exist.

9497 (UCRL—83213) **Status of tandem mirror theory.** Baldwin, D.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Dec 1979. Contract W-7405-ENG-48. 45p. (CONF-791135—4). Dep. NTIS, PC A03/MF A01.

From 21. annual meeting of the American Physical Society; Boston, MA, USA (12 Nov 1979).

This report contains the text and slides used for the review talk on tandem mirror theory presented at the meeting of the Division of Plasma Physics, A.P.S., Boston, MA, November 12-16, 1979. Topics covered include classical confinement, equilibria, MHD- and micro-stability, radial transport, and thermal barriers.

9498 **Dynamic analysis of a fusion system using the system transfer function.** Bian, S. (Babcock & Wilcox Co., Lynchburg, VA). *Nucl. Technol.;* **45**: No. 3, 244-248(Oct 1979).

A simplified approach to determine the dynamic and stability properties in a fusion system has been developed. It is based on the determination of the system transfer functions. A detailed analysis, which includes the interaction among alpha particles, electrons, and ions, shows that the system stability properties, in the sense of the operating conditions of plasma temperature and density in a point-kinetics model, can readily be determined without explicitly solving the time-dependent dynamic equations.

PLASMA INSTABILITIES

9499 (AD-A—070611) **Stability properties of a field-reversed ion layer in a background plasma.** Uhm, H.; Davidson, R.C. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1978. Contracts N00014-75-C-0309;N00014-67-A-0239. 48p. NTIS PC A03/MF A01.

Stability properties of an intense proton layer (P-layer) immersed in a background plasma are investigated within the framework of a hybrid model in which the layer ions are described by the Vlasov equation, and the background plasma electrons and ions are described as macroscopic, cold fluids. Moreover, the stability analysis is carried out for frequencies near multiples of the mean rotational frequency of the layer. It is assumed that the layer is thin, with radial thickness (2a) much smaller than the mean radius (R sub 0). Electromagnetic stability properties are calculated for flute perturbations (del/del z=0) about a P-layer with rectangular density profile, described by the rigid-rotor equilibrium distribution function. Stability properties are investigated including the effects of the equilibrium magnetic field depression produced by the P-layer, transverse magnetic perturbations (delta B not = 0), small (but finite) transverse temperature of the layer ions, and the dielectric properties of the background plasma.

9500 (AD-A—071099) **MHD instability primer. Interim report.** Manheimer, W.; Lashmore-Davies, C. (Naval Research Lab., Washington, DC (USA)). 29 Jun 1979. 140p. NTIS PC A07/MF A01.

This report is a simple, self-contained treaties on MHD instabilities in plasmas. It is the result of a one year work assignment for one of us (WMM) at the Culham Laboratory in Abingdon, England.

9501 (PPPL—1609) **Two-dimensional analysis of trapped-ion eigenmodes.** Marchand, R.; Tang, W.M.; Rewoldt, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1979. Contract EY-76-C-02-3073. 70p. Dep. NTIS, PC A04/MF A01.

A fully two-dimensional eigenmode analysis of the trapped-ion instability in axisymmetric toroidal geometry is presented. The calculations also takes into account the basic dynamics associated with other low frequency modes such as the trapped-electron instability and the ion-temperature-gradient instability. The poloidal structure of the mode is taken into account by Fourier expanding the perturbed electrostatic potential, PHI, in θ.

9502 (WFPS-TME—79-020) **Stability of the plasma in a bundle divertor.** Yang, T.F.; Callen, J.D. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Feb 1979. Contract W-7405-ENG-26. 22p. Dep. NTIS, PC A02/MF A01.

Due to the pressure and magnetic field gradients and curvature of the magnetic field lines in a bundle divertor of a tokamak device, the plasma may be unstable to local interchange modes. Turbulent transport could be quite large and lead to a thick scrape-off layer which is as large as the radius of curvature of the diverted flux bundle. Such turbulence would be beneficial for lowering the energy and particle fluxes on the collector in a bundle divertor. The effect of a bundle divertor on the β limit resulting from the ballooning modes of instability in the central plasma is also estimated. The critical β is reduced by less than one percent.

PLASMA WAVE PHENOMENA

9503 (ORNL/TM—7093) **Self-consistent spectrum of electrostatic drift wave fluctuations due to electron phase space correlations in a sheared magnetic field.** Hirshman, S.P.; Diamond, P.H. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 56p. Dep. NTIS, PC A04/MF A01.

The spectrum of electrostatic universal mode fluctuations due to electron phase space correlations (clumps) in a sheared magnetic field is self-consistently calculated. The pair correlation equation for electrons in a sheared field is derived and renormalized, and an approximate solution for the correlation function is obtained. Using the density correlation function as a source term in Poisson's equation, the renormalized dielectric operator is inverted to obtain the turbulent spectrum. Self-consistency is imposed by requiring that the diffusion coefficient derived from the calculated spectrum equal that used to obtain the spectrum originally. (MOW)

FUSION POWER PLANT TECHNOLOGY

9504 (DOE-tr—210) **Activity report of the research group, January 1-December 31, 1977. Part I.** (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee). [nd]. Translation of EUR-CEA-FC—954. 194p. Dep. NTIS, PC A09/MF A01.

This annual research report includes data on each of the following areas: (1) theoretical and numerical studies, (2) basic physics of ionized gases, (3) TFR 600 construction, (4) experiment management, (5) data processing and electronics, (6) development of ion and neutral beam sources, and (7) TORE II and JET experiments. (MOW)

9505 (DOE-tr—211) **Activity report of the research group, January 1-December 31, 1978. Part I.** (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee). [nd]. Translation of EUR-CEA-FC—995. 397p. Dep. NTIS, PC A17/MF A01.

This report gives extensive information on research progress during this period on the JET program. Theoretical and numerical studies on equilibrium, stability, and transport are reported. The physics of ionized gases and diagnostic techniques are described. A review of the TFR-600 program is given. Further developments of ion sources and neutral injectors are reported. (MOW)

9506 (DOE/ET/52017—3) **Methods of economic analysis applied to fusion research. Third annual report.** Hazelrigg, G.A. Jr. (ECON, Inc., Princeton, NJ (USA)). 18 Dec 1979. Contract EG-77-C-02-4181. 106p. Dep. NTIS, PC A06/MF A01.

The current study reported here has involved three separate tasks. The first re-evaluates previous benefit estimates derived, using

more realistic rates of discount and other parameter changes. The second task investigates other possible commercial uses of technologies which must be developed in providing commercial fusion power. Several such applications have been identified and potential market sizes estimated. The third task develops a methodology for evaluating the impact of additional projects in support technology RD & D on the value of the overall fusion program. This effort has shown that it is possible to economically prioritize RD & D on those functions which will be required in commercial fusion and to provide economic rationales for program changes. The results of this task indicate substantial benefit from increased pursuit of RD & D in several support technology areas. (MOW)

9507 (LA-UR—79-3391) **Preliminary reactor implications of compact tori: how small is compact.** Krakowski, R.A.; Hagenson, R.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6p. (CONF-791225—4). Dep. NTIS, PC A02/MF A01.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The application of simplified but realistic engineering constraints to the special class of wall-stabilized field-reversed theta pinch configurations leads to reactor systems that may be as small as ~ 30 m in length and generating a total thermal power of the order of 500 MWt. Decreased size and power for a given ntau/sub B/ will be accompanied by decreased performance indicators, as reflected in this study by I/sub w/ and the allowable ΔT. It should be noted that this analysis is based upon fixing the duty factor, f/sub I/ = tau/sub s//tau/sub I/. (MOW)

9508 (ORNL/TM—7191) **EBT-P proposed reference design report.** Boch, A.L. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 245p. Dep. NTIS, PC A11/MF A01.

This report describes the proposed reference design for the EBT-P proof-of-principle test device. The device described is a result of broad studies by many participating organizations from industry and from Department of Energy-sponsored fusion research groups, some working together and some in competitive studies, but all with the goal of defining a device at minimum cost and with maximum probability of meeting its goals. This design work is based upon advances in experimental and theoretical understanding of EBT achieved at Oak Ridge National Laboratory. The strategy adopted permits an initial test and validation of the key scaling properties of the ELMO Bumpy Torus concept, with a degree of built-in flexibility to extend the performance parameters toward the condition for containing a fusion reactor plasma. This will lead the way, then, to determination of a later power break-even demonstration and an eventual fusion reactor that can exploit the special high power-density and steady-state properties of the EBT concept.

9509 **Compact fusion reactors using controlled imploding liners.** Burton, R.L.; Turchi, P.J. (Jaycor, Alexandria, Va). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1372-1376(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

In the LINUS approach to thermonuclear fusion, the stabilized implosion of a liquid rotating first wall or liner of lead-lithium alloy is used to heat a D-T plasma by adiabatic compression. The imploded liner is sufficiently thick at peak compression to absorb the fusion neutrons and protect the solid portions of the reactor. The repetition rate of the controlled implosion-plasma compression event and the flow rate of the liner material through the reactor are adjusted to maintain a liner temperature suitable for operating a steam-electric plant. It is shown that the ratio of nuclear energy produced per pulse to the energy supplied to implode the liner, is on the order of unity for economical reactor-sized LINUS systems. The reactor size is calculated for a power output of 700 MW(e) at a pulse rate of 1 Hz. Prototype controlled-liner implosion systems are also described.

9510 **Conceptual design study of a doublet fusion ignition test reactor.** Sager, P. (Gen At Co, San Diego, Calif). pp 2541-2561 of Alternative energy sources. Vol. 5. Veziroglu, T.N. (ed.). Washington, DC; Hemisphere Publishing Corp. (1978).

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

The results of a conceptual design study of an ignition test reactor with niobium-titanium superconducting toroidal field coils are presented. This reactor, which is designed to reach ignition conditions and provide a plasma burn of 30 seconds, has a major radius of 3.8 m, a plasma minor radius of 1.1 m, and a doublet plasma height-to-width ratio of 2.7 m. These specifications were derived from parametric studies in which the overall cost was minimized for a reactor providing a modest ignition margin with Alcator scaling. In addition to the 12 NbTi superconducting TF coils, the major features of the reactor include a water cooled Inconel 625 plasma chamber, normal conducting field shaping coils, highly effective shielding, and a NbTi superconducting induction coil. Twelve 5-MW, 150 keV neutral beam injectors are used for plasma heating. Three pairs of combination cryocondensation/gas bearing turbomolecular pumps are used for plasma chamber vacuum pumping. The remote maintenance system is briefly described.

BLANKET ENGINEERING

9511 (BNL—26883) **Performance of insulating materials for future fusion blankets.** Horn, F.L.; Fillo, J.A.; Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 16p. (CONF-791134—4). Dep. NTIS, PC A02/MF A01.

From 16. international thermal conductivity conference; Chicago, IL, USA (7 Nov 1979).

Thermal conductivities of five candidate insulating materials were determined in the temperature range of 300 to 1000°C in air, argon, and helium @ 1 atm so that a comparison would be made with existing data. These were done in a non-nuclear environment. The test apparatus was a cylindrical shell cooled with water flowing through tubes attached to the shell. The insulation to be tested lined the inner part of the shell which was heated along the axis of the cylinder with a single electric rod heater. (MOW)

9512 (GA-A—15619) **Magnetics aspects of martensitic stainless steels as structural materials for tokamak reactors.** Chen, W.Y.; Peuron, U.A.; Miller, P.H. Jr.; Rawls, J.M.; Rosenwasser, S.N. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76ET51011. 8p. (CONF-791102—56). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Martensitic 9 to 12% chromium steels may offer significant advantages as a first wall/blanket material in terms of greater wall lifetime in comparison with commonly considered materials such as 20CW316. To evaluate the magnetics impact of a ferromagnetic blanket in a tokamak reactor, studies reported here have focused on two potential problem areas: the effects on plasma performance and the impact on the mechanical design of the blanket. A 3-D field code IRON allowing the presence of saturable ferromagnetic material was developed to facilitate the investigation. (MOW)

9513 (GA-A—15626) **Thermal stress analysis and the effect of temperature dependence of material properties on Doublet III limiter design.** McKelvey. T.E.; Koniges, A.E.; Marcus, F.; Sabado, M.; Smith, R. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76ET51011. 8p. (CONF-791102—48). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Temperature and thermal stress parametric design curves are presented for two materials selected for Doublet III primary limiter applications. INC X-750 is a candidate for the medium Z limiter design and ATJ graphite for the low Z design. The dependence of significant material properties on temperature is shown and the impact of this behavior on the decision to actively or passively cool the limiter is discussed. (MOW)

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 9522, 9523

9514 (CONF-791075—3) **Argonne National Laboratory superconducting pulsed coil program.** Wang, S.T.; Kim, S.H. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 23p. Dep. NTIS, PC A02/MF A01.

From International symposium on superconductive energy storage; Osaka, Japan (8 Oct 1979).

The main objectives are to develop high current (~ 100 kA) cryostable cable configurations with reasonably low ac losses, to build a demonstration pulsed coil, and to develop a rather inexpensive large fiberglass reinforced helium cryostat. A 1.5-MJ cryostable pulsed superconducting coil has been developed and constructed at ANL. The coil has a peak field of 4.5 T at an operating current of 11.0 kA. A large inexpensive plastic cryostat has been developed for testing the pulsed coil. The coil has been pulsed with a maximum dB/dt of 11 T/s. The coil was pulsed more than 4000 cycles. Detailed results of the ac loss measurements and the current sharing of the cryostability will be described. (MOW)

9515 (GA-A—15617) **Determination of a permissible size flaw in the Doublet III toroidal field coil.** Reis, E.E.; Sweig, R.A.; Trester, P.W. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76ET51011. 7p. (CONF-791102—50). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The thick plates of copper alloy 155 used for toroidal field coils (B-coils) in Doublet III contain material flaws that originated during the manufacturing of the plate stock. The methodology is

reviewed in which detailed stress analysis, fracture mechanics, and fatigue testing are used to determine what size material flaws are permissible within the finger-joint region of the B-coil for a specified service life of 100,000 cycles under the maximum operating field of 40 kG. This paper presents the results of fatigue investigations of copper alloy 155 containing natural flaws and also with intentionally induced cracks. The nondestructive testing methods used to locate and to determine the dimensions of flaws are reviewed. Service requirements and stress analysis of the B-coil are presented. (MOW)

9516 (LBL—10042) **2 meg-ampere prototype levitated coil for multipole fusion.** Green, M.A.; Glueck, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 8p. (CONF-791102—73). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The coils major diameter is 1.0 meter and it occupies a cross-section which is about 0.2 meter minor in diameter. The prototype coil will carry four times the current of the largest such magnet built to date. As a result, the peak induction in the coil is about 8 T and the stored magnetic energy will be around 3 MJ. The paper describes the proposed Nb_3SN superconductor, the quench protection system which is based on the LBL shorted secondary concept, the isochroic refrigeration storage system which stores about 5 kJ of refrigeration between 4.5°K and 7°K, and the persistent switch.

9517 (LBL—10043) **Use of high current density superconducting coils in fusion devices.** Green, M.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 11p. (CONF-791102—74). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Superconducting magnets will play an important role in fusion research in years to come. The magnets which are currently proposed for fusion research use the concept of cryostability to insure stable operation of the superconducting coils. This paper proposes the use of adiabatically stable high current density superconducting coils in some types of fusion devices. The advantages of this approach are much lower system cold mass, enhanced cryogenic safety, increased access to the plasma and lower cost. (MOW)

9518 (UCRL—82880) **Manufacturing and quality assurance for the MFTF superconductor core.** Scanlan, R.M.; Johnston, J.E.; Waide, P.A.; Zeitlin, B.A.; Smith, G.B.; Nelson, C.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Intermagnetics General Corp., Guilderland, NY (USA)). 1 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—66). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A total of 55,000 m of multifilamentary Nb-Ti superconductor in minimum lengths of 380 m are required for the Mirror Fusion Test Facility. This conductor is a large cross-section monolith and, as such, has presented several new manufacturing challenges. In addition, a monolith requires more stringent quality assurance procedures than braids or cables. This paper describes the manufacturing steps and the quality assurance program which have been developed for the MFTF superconductor core.

9519 (UCRL—82890) **Mirror Fusion Test Facility magnet.** Henning, C.H.; Hodges, A.J.; Van Sant, J.H.; Hinkle, R.E.; Horvath, J.A.; Hintz, R.E.; Dalder, E.; Baldi, R.; Tatro, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—61). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The Mirror Fusion Test Facility (MFTF) is the largest of the mirror program experiments for magnetic fusion energy. It seeks to combine and extend the near-classical plasma confinement achieved in 2XIIB with the most advanced neutral-beam and magnet technologies. The product of ion density and confinement time will be improved more than an order of magnitude, while the superconducting magnet weight will be extrapolated from the 15 tons in Baseball II to 375 tons in MFTF. Recent reactor studies show that the MFTF will traverse much of the distance in magnet technology towards the reactor regime. Design specifics of the magnet are given. (MOW)

9520 (UCRL—82909) **Tandem mirror magnet system for MFTF.** Bulmer, R.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—60). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The Lawrence Livermore Laboratory (LLL) is planning a major extension to the Mirror Fusion Test Facility (MFTF) now under construction at Livermore, CA. This extension brings MFTF to a full tandem mirror configuration, incorporating new ideas for improved plasma confinement. The tandem MFTF is tentatively called MFTF-B. As with most magnetic fusion devices, the confinement coils dominate the overall configuration. This paper concentrates on the MFTF-B magnet configuration, especially field shaping and structural considerations. (MOW)

9521 **Compatibility consideration for zero moment tokamak toroidal field coils.** Gralnick, S.L.; Ojalvo, I.U.; Zatz, I.J.; Balders, T. (Grumman Aerospace Corp., Bethpage, NY). *Nucl. Technol.;* **45**: No. 3, 233-243(Oct 1979).

A toroidal field coil for a small aspect ratio, high field tokamak Ignition Test Reactor was designed based on compound constant tension coil shapes. Finite element analyses revealed the existence of bending stresses in this coil due to incompatible deformations of the different constant tension shapes. Finite element analyses revealed the existence of bending stresses in this coil due to incompatible deformations of the different constant tension shapes at their common joining points. To correct this situation, the deformation equations of constant tension coils were derived and solved analytically. This permitted selection of cross-sectional dimensions for each coil segment that gave compatible deformations and no bending moments at the joining points. Zero moment theory for compound coils was then extended considering nonuniform continuous elastic coil support effects in the governing equations. Analytical and numerical results were obtained for this case as well.

POWER SUPPLIES, ENERGY STORAGE

9522 (CONF-791075—4) **Comparison of flying capacitor bridge circuits and inductor-convertor bridge circuits for the transfer of energy between superconducting coils.** Kustom, R.L. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From International symposium on superconductive energy storage; Osaka, Japan (8 Oct 1979).

Flying Capacitor (FC) bridge circuits and Inductor-Convertor (I-C) bridge circuits have different ratings for identical energy transfer conditions. The design criteria for the two types of circuits are compared for similar energy transfer requirements.

9523 (CONF-791075—5) **Conceptual design of a superconductive energy and transfer system for a commercial tokamak EF coil.** Juja, R.E. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From International symposium on superconductive energy storage; Osaka, Japan (8 Oct 1979).

A conceptual design has been developed for a superconducting energy storage coil and a dc-ac-dc three phase converter which match the voltage and current requirements of the equilibrium field (EF) coil in a commercial tokamak reactor. The system can generate 13 kV, 26 kA peak, 15 kA rms for 15 sec to charge or discharge the EF coil. A hypothetical example utilizing this design and component cost analysis are given. (MOW)

9524 (GA-A—15650) **Electron cyclotron pulse gyroklstron power supply.** Remsen, D.B. Jr. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76ET51011. 8p. (CONF-791102—47). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The system herein described represents utilization of technology developed at Universal Voltronics Corporation in accordance with General Atomic specifications to provide power for a gyrotron developed by Varian Inc. The current designs are derived from experience gained in design of similar systems and the requirements imposed by Varian to supply needs of gyrotron. The technical approach was carefully selected to insure high reliability, high performance, low maintenance time, and best cost trade-off. The gyrotron power supply system is designed to furnish all power, cooling, protection, and mechanical mounting for a pulse gyroklystron. (MOW)

COOLING SYSTEMS

9525 (UCRL—82921) **Integrated cooling system for the Mirror Fusion Test Facility.** Johnson, B.; Chang, Y. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 3p. (CONF-791102—65). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The MFTF components that require water cooling include the neutral beam dumps, ion dumps, plasma dumps, baffle plates, magnet liners, gas boxes, streaming guns, and the neutral beam injectors. A total heat load of nearly 500 MW for 0.5 s dissipates over 4-min intervals. A steady-flow, closed-loop system is utilized. The design of the cooling system assumes that all components require cooling simultaneously. The cooling system contains process instrumentation for loop control. Alarms and safety interlocks are incorporated for the safe operation of the system.

9526 **Alcator liquid nitrogen-cooled tokamaks.** Montgomery, D.B.; Pierce, N.T. (Massachusetts Inst. of Technology, Cambridge). pp 354-366 of Applications of cryogenic technology. Volume 7. Missig, J.R.; Vance, R.W. (eds.). Flushing, NY; Scholium International, Inc. (1978).

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The Alcator machines are present generation compact high-field toroidal confinement devices. They both utilize large quantities of liquid nitrogen for precooling the magnetic field systems, reducing the ohmic power required by a factor of 4 to 7 depending on the temperature rise in the particular magnetic system. The Alcator A device, with a total weight of 9 tons, utilizes approximately 800 gallons of liquid nitrogen to cool-down from room temperature and has been cooled down 250 times. The Alcator C device, with a weight of 40 tons is expected to use about 2400 gallons for cool-down and 60 gallons per pulse for recool. Liquid nitrogen-cooled copper magnetic systems will also play an important role in future larger experimental fusion devices.

HEATING AND FUELING SYSTEMS

REFER ALSO TO CITATION(S) 9524

9527 (LA—8000-C, pp 181-205) **dc electromagnetic launch systems: components and technology.** McNab, I.R.; Deis, D.W.; Mole, C.J. (Westinghouse R & D Center, Pittsburgh, PA). Aug 1979.

From DOE impact fusion workshop; Los Alamos, NM, USA (10 Jul 1979).

Major advances in the technology of electromagnetic launchers can be expected during the next few years, particularly as the result of the DARPA/ARRADCOM program to demonstrate technology for Department of Defense applications. The requirements for impact fusion will necessitate further significant improvements in system and component technology. A sufficient base of information on advanced current collection, homopolar generators and inductors exists that improvement can be foreseen in those areas. However, it is apparent that major emphasis will have to be applied to barrel/rail and projectile technology improvements, and to switching, especially if multi-shot repetitive operation is required.

9528 (LBL—9390) **Arc current modulator for neutral beam source.** DeVries, G.J.; Arthur, A.A.; Baker, W.R.; Fong, E.; Franck, J.V.; Hopkins, D.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 8p. (CONF-791102--82). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The design of an arc current modulator for a 10 x 40 cm neutral beam source is described. The arc modulator has been designed for the TFTR Neutral Beam Source Test Facility. The purpose of the arc modulator is twofold; first, the arc modulator shapes the current rise during the turn on time of the source arc current so that good beam optics are maintained throughout the rise; second, the arc modulator has the capability of regulating the arc current to compensate for power supply ripple and other acceleration voltage fluctuations during the pulse flat top. The maximum current through the arc modulator is 4000 amps which can be switched from the neutral beam source to a parallel circuit of the modulator in the order of a few microseconds, which is required when sparkdown occurs in the source. The arc modulator design is a fast voltage to current converter. (MOW)

9529 (LBL—10088) **Construction of the facility for the testing of the TFTR Neutral Beam Injector.** Haughian, J.; Lou, K.; Roth, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 7p. (CONF-791102—72). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The prototype for the TFTR Neutral Beam Injection System has been assembled at the Lawrence Berkeley Laboraory, and is presently under test. Some of the construction features of the shielding enclosure, the cryogenic supply system, control and computer area, and the auxiliary vacuum and utility supply system are described. In addition, the paper describes the target chamber, its beam dump and cryopanels, and the duct that connects the target chamber to the injector vessel. (MOW)

9530 (ORNL/Sub—01617/14) **Development program for a 200 kW, CW, 28-GHz gyroklystron. Quarterly report No. 14, July-September 1979.** Jory, H.; Conner, C.; Evans, S.; Moran, J.; Symons, R.; Taylor, N. (Varian Associates, Palo Alto, CA (USA). Palo Alto Microwave Tube Div.). 1979. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

The objective of this program is to develop a microwave oscillator capable of producing 200 kW CW power output at 28 GHz. The use of the gyrotron or cyclotron resonance interaction is being pursued. Testing of miter bend tube S/N 2R9 was continued beyond the work described in Quarterly Report No. 13. It failed at 63 kW CW after several hours of operation, due to a cracked collector ceramic. The succeeding miter bend tube, S/N 7, incorporates several changes intended to reduce the heating of that ceramic. Tube S/N 5, an axisymmetric tube, was pulse tested to 195 kW at 1.2% duty. After consultation with ORNL, tests were interrupted and the test station was assigned to tube No. 7. Most of the assemblies of tube S/N 6, another axisymmetric tube, were completed. However, it was decided to delay completion of the tube to allow incorporation of a revised collector ceramic design.

9531 (ORNL/TM—6729) **Oak Ridge TNS program: study of fueling techniques in support of TNS development.** Simpson, W. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 117p. Dep. NTIS, PC A06/MF A01.

The objective of this study was to survey fueling techniques and determine which approaches were compatible with the TNS requirements. Specifically, the following tasks were undertaken: survey of existing fueling concepts for use in TNS, determination of available physical properties for D-T fuel pellets, performance of preliminary load analysis of selected pellet acceleration machines, preparation of conceptual designs, and recommendations for follow-up work. (MOW)

9532 (UCRL—82920) **Designing MFTF thermal absorbers.** Chang, Y. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Nov 1979. Contract W-7405-ENG-48. 4p. (CONF-791102—64). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Both ion dumps and neutral beam dumps have been designed for the Mirror Fusin Test Facility (MFTF) at the Lawrence Livermore Laboratory. Engineering and design has been completed, and fabrication will be contracted to industrial firms in late 1979. This paper presents the performance requirements, heat density, and heat distribution on both dumps. The thermal analysis for determining the dumps' size and methods for cooling them are discussed. Attention is also directed to mechanical design and fabrication as well as to leading-edge design thermal panels.

9533 (UCRL—82972) **Manufacturing of neutral beam sources at Lawrence Livermore Laboratory.** Baird, E.D.; Duffy, T.J.; Harter, G.A.; Holland, E.D.; Kloos, W.A.; Pastrone, J.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Nov 1979. Contract W-7405-ENG-48. 7p. (CONF-791102—62). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Over 50 neutral beam sources (NBS) of the joint Lawrence Berkeley Laboratory (LBL)/Lawrence Livermore Laboratory (LLL) design have been manufactured, since 1973, in the LLL Neutral Beam Source Facility. These sources have been used to provide start-up and sustaining neutral beams for LLL mirror fusion experiments, including 2XIIB, TMX, and Beta II. Experimental prototype 20-kV and 80-kV NBS have also been designed, built, and tested for the Mirror Fusion Test Facility (MFTF). (MOW)

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

9534 (UCRL—83016) **Example of predictive rather than responsive safety research for fusion energy experiments.** Alvares, N.J.; Hasegawa, H.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 7p. (CONF-791102—67). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A fault tree analysis (FTA) was used to study the fire-management systems of two LLL fusion experiments (2XIIB and SHIVA). This technique identified failure modes of existing system components and indicated what the effects of component failure might be in the event of fire in the protected spaces. This paper describes the results of the initial analytical phase of the project and indicates critical unknown parameters required for further analysis. Moreover, the analytical procedures developed are applicable to most, if not all, safety disciplines and could serve as a basis for the logical reestablishment of the FL/SCC by DOE. (MOW)

9535 (UCRL—83017) **Radiological safety design considerations for fusion research experiments.** Crase, K.W.; Singh, M.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—68). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A wide variety of fusion research experiments are in the planning or construction stages. Two such experiments, the Nova Laser Fusion Facility and the Mirror Fusion Test Facility (MFTF), are currently under construction at Lawrence Livermore Labora-

tory. Although the plasma chamber vault for MFTF and the Nova target room will have thick concrete walls and roofs, the radiation safety problems are made complex by the numerous requirements for shield wall penetrations. This paper addresses radiation safety considerations for the MFTF and Nova experiments, and the need for integrated safety considerations and safety technology development during the planning stages of fusion experiments.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 9527

9536 (UCRL—82895) **Potential design modifications for the High Yield Lithium Injection Fusion Energy (HYLIFE) reaction chamber.** Pitts, J.H.; Hovingh, J.; Meier, W.R.; Monsler, M.J.; Powell, E.G.; Walker, P.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 16p. (CONF-791102—4). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Generation of electric power from inertial confinement fusion requires a reaction chamber. One promising type, the High Yield Lithium Injection Fusion Energy (HYLIFE) chamber, includes a falling array of liquid lithium jets. These jets act as: (1) a renewable first wall and blanket to shield metal components from x-ray and neutron exposure, (2) a tritium breeder to replace tritium burned during the fusion process, and (3) an absorber and transfer medium for fusion energy. Over 90% of the energy produced in the reaction chamber is absorbed in the lithium jet fall. Design aspects are included.

9537 (UCRL—82938) **Design of a fiber optic multi-tapped computer bus for a pulsed power control system application.** Gritton, D.G.; Berkbigler, L.W.; Oicles, J.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Oct 1979. Contract W-7405-ENG-48. 22p. (CONF-791102—57). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Control system techniques developed and proven on the Shiva laser have been extended to incorporate new electronic and electo-optic devices as well as conform to unique operational requirements of the 300 terawatt Nova laser system. This paper describes one segment of the control system being designed for the Nova laser currently under design/construction at Lawrence Livermore Laboratory. The specific segment covered is the control system bus structure responsible for power conditioning and real-time control functions.

9538 (UCRL—83057) **Experiments with polymer coated microspheres irradiated by the Shiva laser system.** Auerbach, J.M.; Manes, K.R.; Matthews, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Nov 1979. Contract W-7405-ENG-48. 18p. (CONF-791135—2). Dep. NTIS, PC A02/MF A01.

From 21. annual meeting of the American Physical Society; Boston, MA, USA (12 Nov 1979).

Polymer coated spherical targets have been irradiated by the Shiva laser system in an effort to compress the contained 10 mg/cc DT fuel to super liquid densities. Glass microspheres of 140 μm ID and 5 μm wall thickness with polymer coatings 15 μm to 100 μm thick have been irradiated with laser pulses of 4 kilojoules in 200 psec FWHM. Target performance was diagnosed with neutron yield measurements, radiochemistry, Argon line imaging, and x-ray imaging techniques. Ball in plate targets achieved greater implosion symmetry than free-standing ball targets. With yields of 10^7 to 10^8 neutrons, targets reached DT fuel compressions of several times liquid density.

9539 (UCRL—83092) **Neutron and x-ray emission time measurements.** Lerche, R.A.; Ozawa, J.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Oct 1979. Contract W-7405-ENG-48. 18p. (CONF-791135—3). Dep. NTIS, PC A02/MF A01.

From 21. annual meeting of the American Physical Society; Boston, MA, USA (12 Nov 1979).

Laser fusion targets can produce implosions with a delay between the peak compression (neutron emission) and the laser pulse on the order of 0.2 to 2.5 ns. We use a fast detector system to measure x-ray and D-T neutron emission times with a resolution of 100 to 200 ps. An NE111 fluor (quenched with 2% benzophenone) coupled to a microchannel plate photomultiplier tube detects the arrival of neutrons and x rays. A separate biplanar vacuum photodiode detects the arrival of unabsorbed laser light scattered from the target. These signals are mixed, then recorded on a 500 MHz transient digitizer. The discussion includes a description of the time interval system, experimental data, data analysis techniques, and system calibration.

9540 (UCRL—83163) **Analysis of dense pusher laser-driven implosions for intermediate densities.** Mead, W.C.; Orth, C.D.; Bailey, D.S.; McClellan, G.; Estabrook, K.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Oct 1979. Contract W-7405-ENG-48. 54p. (CONF-791135—5). Dep. NTIS, PC A04/MF A01.

From 21. annual meeting of the American Physical Society; Boston, MA, USA (12 Nov 1979).

Post-shot analysis of targets designed to achieve a diagnosible compression of DT gas to 2. g/cm^3 or 10 x liquid density is reported. The SHIVA laser provided 15 to 20 TW of 1.06 μm laser light. Detailed comparisons of diagnostic results with hydro-code calculations are made. Implications for laser light absorption/scattering, thermal conduction, suprathermal electron preheat, implosion symmetry, and pusher-fuel mix are discussed. Uncertainties of the density determination methods are analyzed. Good overall consistency is found, indicating strong support for the successful attainment of 1.-3. g/cm^3.

9541 (UCRL—83312) **Recent progress in inertial confinement fusion at the Lawrence Livermore Laboratory.** Ahlstrom, H.G.; Manes, K.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1979. Contract W-7405-ENG-48. 25p. (CONF-791047—3). Dep. NTIS, PC A02/MF A01.

From 11. annual electro optics/laser conference and exposition; Anaheim, CA, USA (23 Oct 1979).

The Shiva and Argus laser systems at Livermore have been developed to study the physics of inertial confinement fusion. Both laser system designs are predicated on the use of large aperture Nd-glass disk amplifiers and high power spatial filters. During the past year we have irradiated DT filled microshell targets with and without polymer coatings. Recently new instruments have been developed to investigate implosion dynamics and to determine the maximum fuel density achieved by these imploded fusion pellets. A series of target irradiations with thin wall microshells at 15 to 20 TW, exploding pusher designs, resulted in a maximum neutron yield of 3 x 10^{10}. Polymer coated microshells designed for high compression were subjected to 4 kJ for 0.2 ns and reached fuel densities of 2.0 to 3.0 gm/cm^3. Results of these and other recent experiments will be reviewed.

9542 (UCRL—83527) **Optical testing on the NOVA laser fusion program.** Thomas, N.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Oct 1979. Contract W-7405-ENG-48. 15p. (CONF-791121—3). Dep. NTIS, PC A02/MF A01.

From Workshop on optical fabrication and testing; Tucson, AZ, USA (5 Nov 1979).

The optical testing part of the program requires characterizing index homogeneity of large blanks of fluorophosphate glass, optical surface figure and quality of large polished optics and performance of optical coatings such as antireflection, high reflectors and polarizing beam-splitters. For this purpose, a large effort is being expended to upgrade the optical test facilities at Lawrence Livermore Laboratory in preparation for the NOVA optics procurement. (MOW)

9543 (UCRL—83570) **Design of a high speed rotating mechanical shutter.** Stowers, I.F.; Merritt, B.T.; McFann, C.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Nov 1979. Contract W-7405-ENG-48. 19p. (CONF-791102—7). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A high-speed rotating shutter was designed to operate in a 10^{-6} Torr vacuum at the optical focus of a laser spatial filter. The shutter is basically a wheel, with a single 3 x 10-mm slot at the perimeter, which rotates with a peripheral speed of 1 km/s. The motor to drive the rotating wheel is magnetically suspended and synchronously wound. The wheel achieves a 4 μs opening time and a timing accuracy of better than 0.2 μs. (MOW)

9544 (SAND—79-6003) **Theoretical investigations of shell target compression and burn.** Afanas'ev, Yu.V.; Basov, N.G.; Voloservich, P.P. (AN SSSR, Moscow. Fizicheskij Inst.; AN SSSR, Moscow. Inst. Prikladnoj Matematiki). 26 Sep 1979. Translation of Russian Preprint No. 55, 1978. (CONF-781256—2(Trans)). 15p. Dep. NTIS, PC A02/MF A01.

From 12. European conference on laser interaction with matter; Moscow, USSR (Dec 1978).

On the basis of experimental and theoretical results for thin shell targets, one may expect that: with an increase in laser energy, the absorption will increase and may attain a value of 80%; the effects of pre-heating will play a moderate role; as a result of all types of energy transformations (laser radiation, corona thermal energy, shell kinetic energy), the energy for heating the thermonuclear fuel may be ~10% of the laser energy.

9545 **Co_2-laser fusion.** Stark, E.E. Jr. (Univ of Calif, Los Alamos Sci Lab, NM). *Proc., Intersoc. Energy Convers. Eng. Conf.;* **2**: 1362-1365(1978). (CONF-780801—P2).

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The basic concept of laser fusion is described, with a set of requirements on the laser system. Systems and applications concepts are presented and discussed. The CO_2 laser's characteristics and advantages for laser fusion are described. Finally, technological issues in the development of CO_2 laser systems for fusion applications are discussed.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

9546 (BNL—26880) **Cryosorption pumping of He by charcoal and a compound cryopump design for TSTA.** Hseuh, H.C.; Chou, T.S.; Worwetz, H.A.; Halama, H.J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-791102—71). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

This paper presents the studies of cryosorption pumping of He by charcoal at 4.2°K and between 10 and 20°K. We conclude that coconut charcoal at 4.2°K is suitable for evacuating He from fusion reactors. A compound cryopump design, which utilizes cryocondensation for hydrogen isotopes and cryosorption for helium is also presented.

9547 (CONF-791051—18) **Status of current, routine dosimetry at existing irradiation facilities: flux-spectrum mapping at ORR, RTNS II, and UC Davis facilities.** Greenwood, L.R. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 11p. Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Fusion materials irradiations in reactors, T(d,n), and Be(d,n) neutron sources currently require accurate flux and spectral measurements to characterize the irradiation in terms of displacement damage and gas production. The multiple-foil activation technique is described with emphasis on routinely obtainable accuracy as well as the most outstanding problems and nuclear data needs.

9548 (CONF-791058—59) **Status of neutron dosimetry and damage analysis for the fusion materials program.** Greenwood, L.R. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The status of neutron flux and spectral measurements is described for fusion material irradiations at reactor, T(d,n), Be(d,n), and spallation neutron sources. Such measurements are required for the characterization of an irradiation in terms of displacement damage, gas and transmutant production. Emphasis is placed on nuclear data deficiencies with specific recommendations for cross section measurements and calculations.

9549 (GA-A—15597) **Design considerations for remote maintenance of ETF.** Sager, P.H. Jr.; Hager, E.R. (General Atomic Co., San Diego, CA (USA)). Sep 1979. Contract AT03-76ET51011. 22p. (CONF-791103—52). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The Engineering Test Facility will provide the fusion reactor environment to test components and subsystems to be utilized on demonstration reactors. Target availability is 50%. Remote maintenance is required for components inside the reactor shield but contact work is planned outside the shield and during preparations for access to shielded equipment. Major remote equipment items and R and D needs are described. Cost of (reactor) exposure is proposed as a means to evaluate alternative concepts including maintenance philosophy.

9550 (GA-A—15655) **Application of programmable controllers to vacuum system interlocks.** Lee, G.; Moore, D. (General Atomic Co., San Diego, CA (USA)). Nov 1979. Contract EY-76-C-03-0167-038. 7p. (CONF-791102—81). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

This paper describes the Doublet III Vacuum Control System in which all input signals and output loads are connected to a programmable controller (PC) for logical interfacing. Input signals derived from CAMAC, control panels, limit switches. etc., are implemented as output signals to CAMAC, vacuum valves, pump motors, etc., according to a logic program stored in the PC memory. The memory can be easily programmed by anyone familar with either Boolean algebra or relay-ladder network diagrams. The program data is entered with the aid of a calculator like, keyboard instrument with LED readout displays. The PC system contains a 1024 word RAM memory with a battery backup system to provide 72 hours protection of contents in case of power failure. (MOW)

9551 (HEDL-SA—1899) **Activation consideration for a test cell side watt design in an intense neutron environment.** Huang, S.T.; Chang, J.K.; Bullock, T.P.; Morford, R.J.; Schenter, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 29 Jun 1979. Contract EY-76-C-14-2170. 11p. (CONF-791102—70). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

In the fusion material irradiation test facility (FMIT), an intense neutron radiation is generated by bombarding a liquid lithium target with 35 MeV deuterons. The configuration of the FMIT test cell is a 5 ft x 6 ft x 8 ft cube. The side wall which accomodates the experiment/test assembly is currently specified as 54 inches of steel with the first twelve inches being used as part of the test cell cooling panel. The steel wall is augmented by a 4 ft high density concrete shielding door to provide the necessary biological shield. Stainless steel, carbon steel, and lead were investigated as candidate materials for the side wall. The ANISN-W code was utilized to evaluate the shielding effectiveness as well as production of activation products in the shield. The activation cross section data weighted by the unperturbed neutron flux was compared with the cross section data weighted by the neutron flux in the shield to get the spectrum effect on the cross sections. Impacts of carbon, boron, as well as trace elements of steel impurities on the neutron distribution in the shield as well as on neutron activation were assessed. (MOW)

GENERAL AND MISCELLANEOUS

MANAGEMENT

9552 (DOE/PR—0035) **Procurement orientation course. Handout materials for DOE project officers.** (Department of Energy, Washington, DC (USA)). [nd]. 23p. Dep. NTIS, PC A02/MF A01.

This material begins by discussing the two basic types of contracts used by DOE, firm fixed-price contracts and cost reimbursement contracts. It then takes up in turn the topics of noncompetitive justification and justifications for acceptance of unsolicited proposals, procurement leadtime, preparation of technical evaluation criteria and conduct of technical evaluations, contents of the procurement or assistance plan, and preparation of the statement of work. (RWR)

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 8547, 8793, 8992

9553 (COO—2114-39) **VAX CAMAC software package.** Smith, J. (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics). Nov 1979. Contract EY-76-C-02-2114. 7p. Dep. NTIS, PC A02/MF A01.

A package of routines was written to provide an easy way to code CAMAC instructions. The routines enable one to allocate the JORWAY Camac interface (so that it cannot be used by any other VAX process); to assign a channel to this interface; to issue CAMAC commands to any module in the system crates, or other crates via the branch drivers in the system crates; and finally to issue CAMAC specifically clear, inhibit, or initialize commands.

9554 (MLM—2645) **Introduction to multiple comparison procedures.** Grandillo, A.D. (Mound Facility, Miamisburg, OH (USA)). 28 Nov 1979. Contract EY-76-C-04-0053. 38p. Dep. NTIS, PC A03/MF A01.

This introduction to multiple comparison procedures covers procedures for making linear contrasts and all pairwise multiple comparisons among observed treatment means from designed experiments. Some of the more common and popular multiple comparison procedures of Scheffe, Tukey, Fisher, Student-Newman-Keuls (SNK), Duncan, Duncan-Waller, and Dunnett are described in detail, and examples illustrate their use. Tables of the critical values for the SNK test (Studentized range), Duncan's new multiple range test, and Dunnett's test for comparing several treatments with a control are also given. 27 tables.

9555 (ORNL/CSD/TM—97) **NASTI user's manual.** Gaffney, P.W. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

The use of the NASTI data base is explained. Specifically, NASTI is a Numerical Analysis Software Tutorial Inquirer. It is an interactive program designed to inform computer users of some of the state-of-the-art mathematical routines that exist at Oak Ridge. The information that is provided by NASTI is intended to help users, with mathematical problems, to make the correct choice of a numerical routine. Moreover, in addition to providing help to these

users, NASTI is designed to reduce the possibility of acquiring software that already exists at Oak Ridge. 4 figures, 1 table.

9556 (SLAC-TN—79-7) **Bermuda Triangle: a subsystem of the 168/E interfacing scheme used by Group B at SLAC.** Oxoby, G.J.; Levinson, L.J.; Trang, Q.H. (Stanford Linear Accelerator Center, CA (USA)). Dec 1979. Contract EY-76-C-03-0515. 22p. Dep. NTIS, PC A02/MF A01.

The Bermuda Triangle system is a method of interfacing several 168/E microprocessors to a central system for control of the processors and overlaying their memories. The system is a three-way interface with I/O ports to a large buffer memory, a PDP11 Unibus and a bus to the 168/E processors. Data may be transferred bidirectionally between any two ports. Two Bermuda Triangles are used, one for the program memory and one for the data memory. The program buffer memory stores the overlay programs for the 168/E, and the data buffer memory, the incoming raw data, the data portion of the overlays, and the outgoing processed events. This buffering is necessary since the memories of 168/E microprocessors are small compared to the main program and the amount of data being processed. The link to the computer facility is via a Unibus to IBM channel interface. A PDP11/04 controls the data flow. 7 figures, 4 tables. (RWR)

9557 (UCID—30166(Pt.7)) **Computer graphics by example, Part 7: the TV80LIB graphics library.** O'Hair, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1979. Contract W-7405-ENG-48. 42p. Dep. NTIS, PC A03/MF A01.

TV80LIB is a FORTRAN library of graphics subroutines and device processors. TV80LIB routines are device-independent in that all picture-drawing calls are independent of the particular output device being used. This report, written for the new user, shows by example how to use TV80LIB with CHAT (the compiler for the LRLTRAN language). All libraries used (and the CHAT compiler as well) are available in public files on the CDC 7600 computers of the Livermore Octopus Network. The examples help to illustrate the use of decive processors, drawing routines, and color selection with TV80LIB in an LRLTRAN source program. 13 figures.

9558 (UCRL—83239) **Simulations of local computer networks.** Yeh, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Aug 1979. Contract W-7405-ENG-48. 37p. (CONF-791023—4). Dep. NTIS, PC A03/MF A01.

From 4. local computer networks conference; Minneapolis, MN, USA (22 Oct 1979).

The HYPERchannel Network (i.e., HyperNet) is a commercially available product for local computer networking, using the techniques of Carrier Sense Multiple Access (CSMA) and high-speed (50 Mbits/sec) broadcasting trunks. Recently, several proposed local networks utilizing these HYPERchannel products were simulated. A number of rather surprising performance results were found and published in a series of papers. This paper is a report on the modeling technique employed in the study. This technique can be termed a systematic model construction/validation and incremental modeling approach. The concepts and the applications of the technique for modeling local computer networks are presented. Three levels of increments were used. Each level was systematically constructed and validated according to the level of protocols supported by the HyperNet. The detailed tasks of the model construction and validation for each level of model are discussed. The experiences gained from this simulation study are also reported in terms of time and efforts expanded on each level of modeling. 20 figures.

9559 (LA-tr—78-76) **History of arithmetic. Search for traces of the Abacus system after this method had taken the name algorism. Proofs that during all times up until the 16th century, it was known that common arithmetic originated in this ancient method.** Chasles, M. Translated from *C. R. Hebd. Seances Acad. Sci.;* **17**: No. 4, 143-154(1843). 16p. Dep. NTIS, PC A02/MF A01.

References to the Abacus method in unpublished manuscripts and printed works are cited. They constitute new evidence that common arithmetic did not come from the Arabs, but rather from the Latins. (RWR)

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 8625, 8787

9560 (STAN-CS—79-744) **Performance of update algorithms for replicated data in a distributed database.** Garcia-Molina, H. (Stanford Univ., CA (USA). Dept. of Computer Science). Jun 1979. Contract EY-76-C-03-0515. 320p. Dep. NTIS, PC A14/MF A01.

Thesis.

The performance of update algorithms for replicated data in a distributed database and several other related issues are studied. A simple model of a distributed database which is suitable for studying updates and concurrency control is presented. A performance model and a set of parameters which represent the most important performance features of a distributed database are developed. The distributed database models are used to study the performance of update algorithms for replicated data. This is done in two steps. First the algorithms are analyzed in the case of completely replicated databases in a no-failure, update-only environment. Then, the restrictions are eliminated one at a time, and the impact on the system performance of doing this is evaluated. The MCLA-h algorithm performs better than all other update algorithms in most cases of interest. The MCLA-h algorithm is based on the concept of hole lists. To investigate the validity of our results in a general system, the assumptions made initially in the performance studies are relaxed. It is shown that it is possible to make a centralized control algorithm (like the MCLA-h) resilient in the face of many types of failures. Distributed databases with partitioned data and multiple independent control mechanisms are analyzed. The performance results of the fully duplicated case can be used to design update algorithms in this environment. The processing of updates that do not specify their base set initially is demonstrated. 47 figures, 11 tables.

LAW

9561 (INIS-mf—4810) **Denmark-Federal Republic of Germany: agreement regulating the exchange of information on the construction of nuclear installations along the border.** 1977. 3p. Dep. NTIS (US Sales Only), PC A02/MF A01.

This Agreement signed on 4 July 1977 lays down that the Contracting Parties will inform each other about all nuclear installations constructed along the common border. Nuclear installations within the meaning of the Agreement are installations for the production, processing, reprocessing, manufacture or fission of nuclear fuels. The information to be communicated includes plans and decisions on siting; construction and operation of such installations and relevant documents. The Agreement provides for consultation between the Parties on safety aspects and lays down in detail all the conditions for communication of information.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.
Integral experiments for PWR U-tube steam generators. Part 1: freon facility description and performance test results, 5:8458 (EPRI-NP—1088(Pt.1))

Aerochem Research Labs., Inc., Princeton, NJ (USA)
Silicon halide-alkali metal flames as a source of solar grade silicon. Seventh quarterly report, 5:8250 (DOE/JPL/954777—7)

Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.
Low cost solar array project: composition measurements by analytical photon catalysis. Second quarterly report, 1 January 1979-31 March 1979, 5:8262 (DOE/JPL/955201—2)

Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.
Is the sun constant, 5:9405 (ATR—79(9552)-4)

Agricultural Research Service, Beltsville, MD (USA). Plant Taxonomy Lab.
Ecological distribution of 1000 economic plants, 5:9316 (NP—24018)

AiResearch Mfg. Co., Los Angeles, CA (USA)
Development of a solar desiccant dehumidifier. Volume 1. Summary. Volume 2. Detailed technical information. Technical progress report, 5:8326 (SAN—1591-1)

Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center
Data handbook for the National Solar Energy Demonstration Program, 5:8325 (DSE—5216-T3)

Alaska Univ., Fairbanks (USA). Inst. of Marine Science
Transport and reaction of heavy metals in Alaskan fjord-estuaries. Annual report, July 1, 1978-June 30, 1979, 5:9220 (DOE/EV—70001-50)

Allied Chemical Corp., Morristown, NJ (USA). Corporate Research Center
Photo induced electron transfer reactions in mixed organic-inorganic systems. Final report, 5:8942 (SAN—0034-240-T2)

Allied-General Nuclear Services, Barnwell, SC (USA)
Studies and research concerning BNFP: advanced cask handling studies, 5:8143 (AGNS—35900-1-1-49)

Altas Corp., Santa Cruz, CA (USA)
Proceedings of the workshop on economic and operational requirements and status of large scale wind systems, 5:8412 (CONF-790352—)

Amherst Coll., MA (USA)
Solvent and solute isotope effects in the aqueous solution of gases. Progress report, July 1, 1978-October 31, 1979, 5:8924 (COO—5031-1)

Analytic Sciences Corp., Reading, MA (USA)
Relative potential hazards of radioactive waste in various water systems, 5:8179 (UCRL—15121)

AN SSSR, Moscow. Fizicheskij Inst.
Theoretical investigations of shell target compression and burn, 5:9544 (SAND—79-6003)

AN SSSR, Moscow. Inst. Prikladnoj Matematiki
Theoretical investigations of shell target compression and burn, 5:9544 (SAND—79-6003)

Argonne National Lab., IL (USA)
ALICE: a hybrid Lagrangian-Eulerian code for calculating fluid-structure interaction transients in fast-reactor containment, 5:8526 (ANL—79-72)
Analysis of a coal brokerage for a midwest site, 5:8050 (ANL/CNSV-TM—21)
Analysis of EBR-II blanket dosimetry, 5:8512 (CONF-791051—16)
Argonne National Laboratory superconducting pulsed coil program, 5:9514 (CONF-791075—3)
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Comparison of impacts of heating alternatives on minority employment for northern US cities, 5:8634 (CONF-791009—17)
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Conceptual design of a superconductive energy and transfer system for a commercial tokamak EF coil, 5:9523 (CONF-791075—5)
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Effect of sulfation accelerators on the corrosion behavior of materials in fluidized-bed environments, 5:8858 (CONF-7910110—1)
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Environmental assessment of the utilization of alcohol fuels in highway vehicle applications, 5:8639 (CONF-791009—19)
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Multiple nucleon transfer in damped nuclear collisions, 5:9467 (LBL—9638)

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Isotope correlations and measurements in the United States, 5:8181 (CONF-7910112—1)
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Light-water-reactor safety research program. Quarterly progress report, April-June 1979, 5:8558 (NUREG/CR—1164)
Markets for new transportation technologies, 5:8780 (CONF-791009—14)
Materials technology for coal-conversion processes. Seventeenth quarterly report, January-March 1979, 5:8008 (ANL—79-56)
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Neutron dosimetry for radiation damage in fission and fusion reactors, 5:9474 (CONF-791058—56)
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Resonant dissociation in N_2 by electron impact: a source of heating in the thermosphere and auroras, 5:9411 (CONF-790996—2)
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Status of neutron dosimetry and damage analysis for the fusion materials program, 5:9548 (CONF-791058—59)
Studies of nuclear-waste migration in geologic media. Annual report, October 1977-September 1978, 5:8175 (ANL—79-30)
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Total-neutron cross sections of heavy nuclei, 5:9462 (CONF-791058—61)
Uncertainties and covariances of spectra derived from integral measurements, 5:9473 (CONF-791051—17)
World Energy Data System (WENDS). Volume I. Country data, AF-CO, 5:8619 (ANL-PMS—79-2(Vol.1))
World Energy Data System (WENDS). Volume II. Country data, CZ-KS, 5:8620 (ANL-PMS—79-2(Vol.2))
World Energy Data System (WENDS). Volume III. Country data, LY-PO, 5:8621 (ANL-PMS—79-2(Vol.3))
World Energy Data System (WENDS). Volume IV. Country data, SG-YO, 5:8622 (ANL-PMS—79-2(Vol.4))
World Energy Data System (WENDS). Volume V. International organization data, 5:8623 (ANL-PMS—79-2(Vol.5))
World Energy Data System (WENDS). Volume VI. International agreement profiles, 5:8666 (ANL-PMS—79-2(Vol.6))

Army Armament Research and Development Command, Dover, NJ (USA). Large Caliber Weapon Systems Lab.
Hazards analysis of energy recovery from army ammunition plant solid waste. Final report, 5:8802 (AD-A—070519)

Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee
Activity report of the research group, January 1-December 31, 1977. Part I, 5:9504 (DOE-tr—210)
Activity report of the research group, January 1-December 31, 1978. Part I, 5:9505 (DOE-tr—211)

Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee
Annual progress report of the Fontenay-aux-Roses Research Group. January 1 to December 31 1977, 5:9492 (EUR-CEA-FC—954(pt.1))
Electric field distribution associated with lower hybrid heating of a Tokamak plasma, 5:9486 (CEA-CONF—4257)
Resonant magnetic pumping at very low frequency, 5:9487 (CEA-CONF—4258)
Synchrotron radiation from high temperature plasmas, 5:9495 (CEA-CONF—4224)

Atomenergikommissionen, Copenhagen (Denmark)
Geologic waste disposal and a model for the surface movement of radionuclides, 5:8172 (SAND—79-0907C)

Atomic Energy Establishment, Inshas (Egypt)
IBM-1620 code for calculation of isotopic composition of irradiated thorium (ISOCOM-2), 5:8785 (AREAEE—206)

Australian Atomic Energy Commission, Coogee
Quantitative techniques for nuclear plant safety assessment and design, 5:8540 (INIS-mf—4777)

B

Babcock and Wilcox Co., Alliance, OH (USA). Contract Research Div.
Qualification of the B and W Mark B fuel assembly for high burnup. First semi-annual progress report, July-December 1978, 5:8457 (COO—4711-19)

Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.
Qualification of the B and W Mark B fuel assembly for high burnup. First semi-annual progress report, July-December 1978, 5:8457 (COO—4711-19)

Babcock and Wilcox Co., Lynchburg, VA (USA). Research and Development Div.
Qualification of the B and W Mark B fuel assembly for high burnup. First semi-annual progress report, July-December 1978, 5:8457 (COO—4711-19)

Badger Plants, Inc., Cambridge, MA (USA)
Conceptual design of a coal-to-methanol-to-gasoline commercial plant. Volume 3: environmental. Second interim final report, August 31, 1977-March 1, 1979, 5:8016 (FE—2416-43(Vol.3))
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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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CONF-7805163-	(Workshop on modeling of Electrical and Electromagnetic methods, Berkeley, CA, USA, 17-19 May 1978)	
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CONF-7805191-	(Spring meeting of the Swedish Association for Water Hygiene, Gothenburg, Sweden, 9-10 May 1978)	
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	5:8829	Dep. NTIS, PC A23/MF A01
CONF-790858-	(4. international symposium on environmental biogeochemistry, Canberra, Australia, 27 Aug-5 Sep 1979)	
1	5:9271	Dep. NTIS, PC A02/MF A01
CONF-790864-	(Community renewable energy systems conference, Boulder, CO, USA, 20-21 Aug 1979)	
2	5:8236	Dep. NTIS, PC A02/MF A01
CONF-790885-	(9. international symposium on lepton and photon interactions at high energy, Batavia, IL, USA, 23-29 Aug 1979)	
8	5:9418	*See* BNL-26829
10	5:9425	*See* FERMILAB-Conf-79/74-THY
CONF-790896-	(Workshop on techniques for measurement of thermodynamic properties, Albany, OR, USA, 21-23 Aug 1979)	
1	5:8399	*See* LBL-9621
CONF-790898-	(8. Hawaii topical conference in particle physics, Honolulu, HI, USA, 8-21 Aug 1979)	
(Summ)	5:9415	*See* UH-511-360-79
CONF-790902-	(Impact of advanced systems on scientific computations, Livermore, CA, USA, 12-13 Sep 1979)	
3	5:8527	Dep. NTIS, PC A02/MF A01
CONF-790923-	(Decontamination and decommissioning of nuclear facilities conference, Sun Valley, ID, USA, 16-19 Sep 1979)	
9	5:8177	*See* RHO-SA-104
CONF-790927-	(Linear accelerator conference, Montauk, NY, USA, 10-14 Sep 1979)	
33	5:9001	*See* LA-UR-79-3373
CONF-790973-	(Knoxville Technical Society meeting, Knoxville, TN, USA, 10 Sep 1979)	
1	5:8658	Dep. NTIS, PC A02/MF A01
CONF-790975-	(CPIA-JANNAF combustion conference, Monterey, CA, USA, 10-14 Sep 1979)	
2	5:9037	*See* LA-UR-79-2769
4	5:9038	*See* LA-UR-79-3106
5	5:9040	*See* SAND-79-1169C
CONF-790976-	(International symposium on future directions in studies of nuclei far from stability, Nashville, TN, USA, 10-13 Sep 1979)	
8	5:9444	Dep. NTIS, PC A02/MF A01
CONF-790977-	(Conference on health effects of energy production, Ontario, Canada, 12-14 Sep 1979)	
2	5:9320	Dep. NTIS, PC A02/MF A01
CONF-790991-	(Photovoltaic advanced R and D annual review meeting, Denver, CO, USA, 17-19 Sep 1979)	
2	5:8287	*See* COO-4094-50
CONF-790996-	(Symposium on electron-molecule collisions satellite meeting, Tokyo, Japan, 6-7 Sep 1979)	
2	5:9411	Dep. NTIS, PC A02/MF A01
CONF-790998-	(Design automation conference, St. Louis, MO, USA, 12 Sep 1979)	
1	5:8586	Dep. NTIS, PC A03/MF A01
CONF-790999-	(2. annual conference of applied research and practice on municipal and industrial waste, Madison, WI, USA, 18-21 Sep 1979)	
1	5:8222	Dep. NTIS, PC A02/MF A01
CONF-7909104-	(10. international symposium on multiparticle dynamics, Goa, India, 25-29 Sep 1979)	
1	5:9424	*See* SLAC-PUB-2423
CONF-7909108-	(Workshop on the future of large-scale energy systems, Honolulu, HI, USA, 16-22 Sep 1979)	
1	5:8654	Chicago, IL; Institute of Gas Technology (1979).
CONF-791008-	(ASNT fall conference, St Louis, MO, USA, 15-19 Oct 1979)	
4	5:8479	*See* HEDL-SA-1932
CONF-791009-	(International conference on energy use management, Los Angeles, CA, USA, 22-26 Oct 1979)	
10	5:8704	Chicago, IL; Institute of Gas Technology (1979).
13	5:8062	Dep. NTIS, PC A02/MF A01
14	5:8780	Dep. NTIS, PC A02/MF A01
15	5:8799	Dep. NTIS, PC A02/MF A01
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20	5:9339	Dep. NTIS, PC A02/MF A01
21	5:8810	Dep. NTIS, PC A02/MF A01
22	5:8811	Dep. NTIS, PC A02/MF A01
CONF-791013-	(26. national vacuum symposium, New York, NY, USA, 2-5 Oct 1979)	
9	5:9413	*See* SAND-79-2305C
CONF-791021-	(2. American Electroplaters Society symposium on coatings for solar collectors, St Louis, MO, USA, 16-17 Oct 1979)	
1(Rev.)	5:8372	*See* LBL-9324(Rev.)
CONF-791023-	(4. local computer networks conference, Minneapolis, MN, USA, 22-23 Oct 1979)	
4	5:9558	*See* UCRL-83239
CONF-791024-	(Solar industrial process heat conference, San Francisco, CA, USA, 31 Oct-2 Nov 1979)	
6	5:8342	*See* SAND-79-1292C
CONF-791037-	(IEEE nuclear science symposium, San Francisco, CA, USA, 17-19 Oct 1979)	
5	5:8478	*See* HEDL-SA-1903-FP
6	5:9025	Dep. NTIS, PC A02/MF A01
8	5:9471	*See* SLAC-PUB-2417
12	5:8522	*See* HEDL-SA-1900
14	5:8510	*See* BNL-26970
15	5:9004	*See* LBL-9841
16	5:9014	*See* LBL-9759
17	5:9023	*See* LBL-9979
CONF-791045-	(American Ceramic Society conference, New Orleans, LA, USA, 14-17 Oct 1979)	
5	5:8135	*See* HEDL-SA-1830
CONF-791047-	(11. annual electro optics/laser conference and exposition, Anaheim, CA, USA, 23-25 Oct 1979)	
3	5:9541	*See* UCRL-83312
4	5:9412	*See* LBL-9988
CONF-791049-	(23. conference on analytical chemistry in energy technology, Gatlinburg, TN, USA, 9-11 Oct 1979)	
17	5:8183	*See* LA-UR-79-2760
21	5:8904	*See* RHO-SA-81
22	5:9015	*See* LBL-9915
CONF-791051-	(3. ASTM-EURATOM symposium on reactor dosimetry, Ispra, Italy, 1-5 Oct 1979)	
4	5:8525	*See* LA-UR-79-2686
8	5:9018	*See* HEDL-SA-1815
11	5:8523	*See* HEDL-SA-1942-FP
13	5:9021	*See* HEDL-SA-1782-FP

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15	5:8832	*See* HEDL-SA-1939-FP
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17	5:9473	Dep. NTIS, PC A02/MF A01
18	5:9547	Dep. NTIS, PC A02/MF A01
CONF-791058-	(International conference on nuclear cross sections for technology, Knoxville, TN, USA, 22-26 Oct 1979)	
28	5:8498	Dep. NTIS, PC A02/MF A01
49	5:9430	*See* HEDL-SA-1910
51	5:9441	*See* BNL-26885
52	5:9440	*See* BNL-26884
54	5:9445	Dep. NTIS, PC A02/MF A01
55	5:9435	Dep. NTIS, PC A02/MF A01
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58	5:9461	Dep. NTIS, PC A02/MF A01
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60	5:9437	Dep. NTIS, PC A02/MF A01
61	5:9462	Dep. NTIS, PC A02/MF A01
62	5:9463	Dep. NTIS, PC A02/MF A01
CONF-791064-	(Conference of the origins of chloroplasts, session 3, origin and evolution of the chloroplast metabolism, Washington, DC, USA, 3-5 Oct 1979)	
1	5:9307	*See* LBL-9895
CONF-791069-	(6. annual conference on energy, Rolla, MO, USA, 16-18 Oct 1979)	
3	5:8587	Dep. NTIS, PC A02/MF A01
CONF-791075-	(International symposium on superconductive energy storage, Osaka, Japan, 8-10 Oct 1979)	
3	5:9514	Dep. NTIS, PC A02/MF A01
4	5:9522	Dep. NTIS, PC A02/MF A01
5	5:9523	Dep. NTIS, PC A02/MF A01
CONF-791086-	(US/United Kingdom information exchange on dissolution of nuclear fuel, Windscale, UK, 16-18 Oct 1979)	
1	5:8141	*See* HEDL-SA-1934
2	5:8140	*See* HEDL-SA-1931
CONF-791088-	(National safety congress, Chicago, IL, USA, 15-19 Oct 1979)	
1	5:9267	*See* UCAR-10046
CONF-791093-	(Cost schedule control system conference, San Diego, CA, USA, 31 Oct-2 Nov 1979)	
1	5:8989	*See* HEDL-SA-1961-FP
CONF-791097-	(4. biennial conference and workshop on wind energy conversion systems, Washington, DC, USA, 28-31 Oct 1979)	
2	5:8402	*See* SERI-TP-354-466
CONF-791098-	(WANTO meeting, Oak Ridge, TN, USA, 9-11 Oct 1979)	
1	5:8990	*See* LA-UR-79-3071
CONF-7910101-	(Symposium on optical materials for high power lasers, Boulder, CO, USA, 30-31 Oct 1979)	
1	5:8893	Dep. NTIS, PC A02/MF A01
CONF-7910102-	(ASTM symposium on fatigue crack growth measurement and data analysis, Pittsburgh, PA, USA, 29 Oct-2 Nov 1979)	
1	5:8842	*See* HEDL-SA-1809
2	5:8843	*See* HEDL-SA-1810
CONF-7910103-	(Workshop on the production of new particles in super high energy collisions, Madison, WI, USA, 22-24 Oct 1979)	
1	5:9426	*See* LBL-10094
CONF-7910106-	(Society of Manufacturing Engineers conference, Detroit, MI, USA, 29 Oct-1 Nov 1979)	
1	5:8136	*See* HEDL-SA-1832-FP
CONF-7910108-	(Symposium on separation science and technology for energy applications, Gatlinburg, TN, USA, 30 Oct-2 Nov 1979)	
1	5:8938	*See* LA-UR-79-3357
CONF-7910109-	(Meeting of the IMOG machine tool subgroup, Oak Ridge, TN, USA, 24 Oct 1979)	
1	5:8960	*See* LA-UR-79-3353
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1	5:8858	Dep. NTIS, PC A02/MF A01
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1	5:8181	Dep. NTIS, PC A02/MF A01
2	5:8472	Dep. NTIS, PC A03/MF A01
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4	5:9536	*See* UCRL-82895
7	5:9543	*See* UCRL-83570
47	5:9524	*See* GA-A-15650
48	5:9513	*See* GA-A-15626
50	5:9515	*See* GA-A-15617
56	5:9512	*See* GA-A-15619
57	5:9537	*See* UCRL-82938
58	5:9488	*See* UCRL-82922
59	5:9490	*See* UCRL-82975
60	5:9520	*See* UCRL-82909
61	5:9519	*See* UCRL-82890
62	5:9533	*See* UCRL-82972
63	5:9493	*See* UCRL-82919
64	5:9532	*See* UCRL-82920
65	5:9525	*See* UCRL-82921
66	5:9518	*See* UCRL-82880
67	5:9534	*See* UCRL-83016
68	5:9535	*See* UCRL-83017
70	5:9551	*See* HEDL-SA-1899
71	5:9546	*See* BNL-26880
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74	5:9517	*See* LBL-10043
80	5:9489	*See* GA-A-15656
81	5:9550	*See* GA-A-15655
82	5:9528	*See* LBL-9390
CONF-791103-	(American Nuclear Society meeting, San Francisco, CA, USA, 12-16 Nov 1979)	
48	5:9190	Dep. NTIS, PC A02/MF A01
52	5:9549	*See* GA-A-15597
57	5:8138	*See* GA-A-15595
59	5:8518	*See* HEDL-SA-1850
60	5:8139	*See* HEDL-SA-1857
61	5:8533	*See* HEDL-SA-1835
CONF-791108-	(72. AICHE meeting, San Francisco, CA, USA, 25-29 Nov 1979)	
9	5:8144	*See* DPSP-AFR-79-6-3
10	5:8023	Chicago, IL; Institute of Gas Technology (1979).
11	5:8028	Chicago, IL; Institute of Gas Technology (1979).
CONF-791112-	(Symposium on the scientific basis for nuclear waste management, Boston, MA, USA, 26-29 Nov 1979)	
18	5:8172	*See* SAND-79-0907C
22	5:8176	*See* SAND-79-0896C
26	5:8156	*See* LBL-9903
27	5:9396	*See* LBL-9884
43	5:8147	Dep. NTIS, PC A02/MF A01
45	5:8154	Dep. NTIS, PC A02/MF A01
CONF-791117-	(ANS topical conference, Kiawah Island, SC, USA, 26-19 Nov 1979)	
6	5:8184	*See* LA-UR-79-3191
8	5:8185	*See* LA-UR-79-3205
17	5:8902	*See* RFP-2943
18	5:8520	*See* HEDL-SA-1854FP
CONF-791118-	(7. water reactor safety research information meeting, Gaithersburg, MD, USA, 5-9 Nov 1979)	
5	5:8866	*See* HEDL-SA-1949
6	5:8456	Dep. NTIS, PC A03/MF A01
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	5:8867	*See* HEDL-SA-1983
	5:8868	*See* HEDL-SA-1983
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	5:8876	*See* HEDL-SA-1983
CONF-791121-	(Workshop on optical fabrication and testing, Tucson, AZ, USA, 5-7 Nov 1979)	
3	5:9542	*See* UCRL-83527
CONF-791123-	(Water reactor safety meeting, Washington, DC, USA, 5-9 Nov 1979)	
3	5:8528	Dep. NTIS, PC A02/MF A01
CONF-791125-	(13. Asilomar conference on circuits, systems, and computers, Pacific Grove, CA, USA, 5-6 Nov 1979)	
3	5:9029	*See* SAND-79-2074C

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2	5:8884	*See* BNL-26813
6	5:8218	Chicago, IL; Inst. of Gas Technology (1979).
7	5:8206	Chicago, IL; Institute of Gas Technology (1979).
CONF-791134-		(16. international thermal conductivity conference, Chicago, IL, USA, 7-9 Nov 1979)
4	5:9511	*See* BNL-26883
CONF-791135-		(21. annual meeting of the American Physical Society, Boston, MA, USA, 12-16 Nov 1979)
2	5:9538	*See* UCRL-83057
3	5:9539	*See* UCRL-83092
4	5:9497	*See* UCRL-83213
5	5:9540	*See* UCRL-83163
CONF-791136-		(Symposium on error analysis of ecological models, Vienna, Austria, 20 Nov 1979)
1	5:9191	Dep. NTIS, PC A03/MF A01
CONF-791137-		(Engineering Foundation conference on automated cytology, Pacific Grove, CA, USA, 25-30 Nov 1979)
1	5:9296	*See* LA-UR-79-3268
CONF-791142-		(International Conference on crystal field and structural effects in f-electron systems, Philadelphia, PA, USA, 12-15 Nov 1979)
5	5:9481	*See* BNL-26976
CONF-791146-		(2. symposium on automation technology in engineering drawing, Monterey, CA, USA, 13-15 Nov 1979)
1	5:8961	*See* UCRL-83663
CONF-791149-		(IWGFR specialists meeting on carbon in sodium, Harwell, UK, 26-28 Nov 1979)
1	5:8480	*See* HEDL-SA-1950-FP
CONF-791153-		(Joint AT-E division seminar, Los Alamos, NM, USA, 14 Nov 1979)
1	5:9033	*See* SLAC-PUB-2420
CONF-791154-		(Specialists meeting on process heat applications technology, Julich, F.R. Germany, 27-29 Nov 1979)
1	5:8497	*See* GA-A-15685
CONF-791156-		(Geological Society of America annual meeting, San Diego, CA, USA, 5-8 Nov 1979)
1	5:8132	*See* LA-UR-79-3376
CONF-791157-		(Conference on group theoretical methods in physics, Zvenigorod, USSR, 28-30 Nov 1979)
1	5:9429	*See* LA-UR-79-3326
CONF-791203-		(Health Physics Society meeting, Honolulu, HI, USA, 10-14 Dec 1979)
6	5:9380	Dep. NTIS, PC A02/MF A01
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3	5:8387	*See* LA-UR-79-3043
4	5:8562	*See* LA-UR-79-3098
8	5:8210	Chicago, IL; Institute of Gas Technology (1979).
10	5:8216	*See* SAND-79-8647
12	5:8237	*See* LA-UR-79-3390
CONF-791205-		(ASME winter annual meeting, New York, NY, USA, 2-7 Dec 1979)
16	5:8521	*See* HEDL-SA-1860
CONF-791215-		(DECUS 1979 fall symposium, San Diego, CA, USA, 10-13 Dec 1979)
2	5:9003	*See* LA-UR-79-3178
CONF-791216-		(Conference on long-term energy resources, Montreal, Canada, 3-4 Dec 1979)
1	5:8396	*See* LA-UR-79-3256
CONF-791218-		(6. annual conference of the data general users group, New Orleans, LA, USA, 4 Dec 1979)
2	5:8968	*See* LA-UR-79-3276
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1	5:9433	Dep. NTIS, PC A02/MF A01
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1	5:8986	*See* SAND-79-1318C
CONF-791221-		(Semiannual conference for advanced solar thermal technology, Phoenix, AZ, USA, 11-13 Dec 1979)
1	5:8375	*See* SERI/TP-333-485
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1	5:8773	*See* LA-UR-79-3354
CONF-791223-		(NEANDC specialist meeting on neutron cross sections of fission product nuclei, Bologna, Italy, 12-14 Dec 1979)
1	5:9439	*See* LA-UR-79-3332
CONF-791225-		(Symposium on compact toruses and energetic particle injection, Princeton, NJ, USA, 11-14 Dec 1979)
4	5:9507	*See* LA-UR-79-3391
CONF-800102-		(International conference on geotechnical and environmental aspects of geopressure energy, Sea Island, GA, USA, 13-20 Jan 1980)
1	5:8394	*See* UCRL-83122
CONF-800106-		(14. photovoltaics specialists conference, San Diego, CA, USA, 7-10 Jan 1980)
2	5:8275	*See* SAND-79-1406C
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2	5:9045	*See* BNL-26840
3	5:9046	*See* BNL-26841
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1	5:8820	*See* SAND-79-8685
2	5:8784	*See* LA-UR-79-2826
CONF-800302-		(25. international gas turbine conference, New Orleans, LA, USA, 9-13 Mar 1980)
1	5:8955	*See* DOE/NASA/2593-79/10
CONF-800303-		(179. national meeting of the American Chemical Society, Houston, TX, USA, 23-28 Mar 1980)
1	5:8890	*See* BNL-26864
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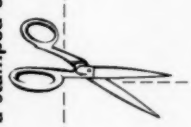

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